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Rotary Balance Data for a Typical Single-Engine Low-Wing General Aviation Design for an Angle-of-Attack Range of 30° to 90°

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SUMMARY

Aerodynamic characteristics obtained in a spinning flow environment utilizing a rotary balance located in the Langley spin tunnel are presented in plotted form for a 1/5-scale, single-engine, low-wing, general aviation airplane model. The configurations tested included the basic airplane, various airfoil shapes, tail designs, fuselage strakes and modifications as well as airplane components. Data are presented for pitch and roll angle ranges of 30 to 90° and 10 to -10°, respectively, and clockwise and counter-clockwise rotations covering an $\frac{\Omega b}{2V}$ range from 0 to .9. The data are presented without analysis.

INTRODUCTION

The NASA Langley Research Center has initiated a broad general aviation stall/spin research program which includes spin-tunnel and free-flight radio control model tests, as well as full-scale flight tests for a number of configurations typical of light general aviation airplanes. As a supporting part of this effort, a series of static and rotary balance wind tunnel force tests covering these same configurations will be conducted to establish a data base for analysis of model and full-scale flight results, and to be used in the development of design charts for desirable stall/spin characteristics.

The first force test program involved static wind tunnel tests (ref. 1) of a typical single-engine, low-wing, general aviation aircraft configuration in the Ames Research Center 12-foot Pressure Tunnel. During these tests, data were obtained for the basic configuration and for modifications previously investigated on a 1/11-scale spin-tunnel model (ref. 2). These modifications consisted of different airfoil shapes, tail designs, fuselage strakes and fuselage shapes. In addition, airplane component (i.e., fuselage alone, fuselage-wing, etc.) data were acquired. All the configurations tested statically were then tested in a spinning flow environment utilizing a rotary balance located in the Langley spin tunnel. The

data obtained during the rotary tests are reported herein, and a subsequent report will present an analysis of the data.

SYMBOLS

The units for physical quantities used herein are presented in the International System of Units (SI) and U.S. Customary Units. The measurements were made in the U.S. Customary Units, and equivalent dimensions were determined by using the conversion factors given in reference 3.

b wing span, m (ft)

$\bar{c}$ mean aerodynamic chord, cm (in.)

C_N normal-force coefficient, $\frac{\text{Normal force}}{qS}$

C_Y side-force coefficient, $\frac{\text{Side force}}{qS}$

C_ℓ rolling moment coefficient, $\frac{\text{Rolling moment}}{qSb}$

C_m pitching-moment coefficient, $\frac{\text{Pitching moment}}{qS\bar{c}}$

C_n yawing-moment coefficient, $\frac{\text{Yawing moment}}{qSb}$

q free-stream dynamic pressure

R_E Reynolds number

S wing area, m^2 (ft^2)

α angle of attack, $\tan^{-1}(\tan\theta\cos\phi)$, deg

β angle of sideslip, $\sin^{-1}(\sin\theta\sin\phi)$ deg

θ angle of pitch, angle between spin axis and the longitudinal body axis, deg

ϕ angle of roll, angle between horizontal and lateral body axis, positive when right wing down, deg

Ω angular velocity about spin axis, rad/sec

$\frac{\Omega b}{2V}$ spin coefficient, positive for right spin

δ_a aileron deflection, positive when right aileron is down $(\delta_{a_R}-\delta_{a_L})/2$, deg

δ_e elevator deflection, positive when trailing edge is down, deg

δ_r rudder deflection, positive when trailing edge is to left, deg

Abbreviations:

F forward of cg

cg center of gravity

LE leading edge

rpm revolutions per minute

SR spin radius

TE trailing edge

ROTARY BALANCE APPARATUS

Background

A rotary balance measures the forces and moments acting on an airplane while subjected to the rotational flow conditions existing during a spin. The need for this type of information was recognized early in the development of the airplane. For example, early researchers (ref. 4) noted in 1928 that the use of "straight" force tests are likely to lead to erroneous conclusions when applied to the spin. NACA investigators at that time developed a "spinning" balance (ref. 5) installed in a 5-foot vertical tunnel since they appreciated that subjecting all components of an airplane model to a constant velocity vector during static force tests was a poor simulation of the flow conditions existing in a spin. The table below illustrates the significance of rota-

tion rate on the velocity vector when the spin axis passes through the cg for the airplane configuration tested herein at an angle of attack and sideslip of 80° and 0°, respectively, at the cg.

	$\Delta\alpha$		$\Delta\beta$	
$\frac{\Omega b}{2V}$[1]	INBOARD WING TIP	OUTBOARD WING TIP	TAIL TE	NOSE LE
0.0	0.0	0.0	0.0	0.0
0.2	11.5	-10.8	-11.9	4.9
0.4	23.0	-20.2	-22.9	10.9
0.6	33.4	-28.2	-32.3	14.5
0.8	42.5	-34.7	-40.2	19.0
1.0	50.0	-40.0	-46.5	23.3

It can be seen that for a high rotation rate ($\frac{\Omega b}{2V} = 1.0$) a difference of 90° in angle of attack would exist between the wing tips such that the local angle of attack of the inboard and outboard tips is 130 and 40°, respectively. At the same time, the sideslip is of opposite sign forward and aft of the cg, resulting in a 70° difference in sideslip angle between the nose and tail. These large variations in the velocity vector certainly warrant the concern expressed in the applicability of static force measurements in predicting the existence of spin equilibrium conditions.

The usefulness of the early NACA "spinning" balance was limited, however, by the size of the models and tunnel, and the 6-component balance was mounted external to the model and was large relative to the model. Consequently, by 1945, a "rotary" balance was developed and installed in the Langley 20-foot spin tunnel which is described in reference 6. Unfortunately, this was the

[1] Rates of rotation have been traditionally expressed nondimensionally in terms of the linear and angular velocities V and Ω, respectively, and half the wing span. The expression $\frac{\Omega b}{2V}$ is consequently the ratio of the wing tip speed to the forward speed and is analogous to the arc tangent of the helix angle at the wing tip.

first and last report to be issued relative to the apparatus because of difficulty in obtaining repeatable data and the considerable effort required to obtain and reduce the measurements.

In recent years, NASA installed a rotary balance apparatus in the Langley Full-Scale Tunnel and sponsored studies, such as reference 7 and 8, to determine the ability of current analytical techniques to compute the flight motions of current fighter airplane configurations. These studies clearly demonstrated the need to model the effects of spin rotation rate on the aerodynamic characteristics in all phases of the spinning motion. As a result of these experimental and analytical efforts, NASA subsequently modernized the rotary balance installed in the spin tunnel. The data presented herein were obtained with this up-dated apparatus after validation tests (see Appendix) were performed.

Test Equipment

A photograph and sketch of the present rotary balance apparatus installed in the Langley spin tunnel are shown in figures 1 and 2, respectively. The rotating portion of the balance system, mounted on a horizontal supporting boom which is hinged at the wall, is moved from the wall to the center of the tunnel by cables. The rotary arm of the balance system, which rotates about a vertical axis, is attached to the outer end of the horizontal supporting boom and is driven by a drive shaft through couplings and gears.

A test model is mounted on a strain gauge balance which is affixed to the bottom of the rotary balance apparatus. Controls located outside the tunnel are used to activate motors on the rig which position the model to the desired attitude. The pitch angle range of the rig is 0 to 90 degrees and the roll angle range is ± 15 degrees. The spin radius and the lateral displacement motors allow the operator to position the moment center of the balance on the spin axis or at a specific distance from the spin axis. This is done for each combination of pitch and roll angle. The

general practice is to mount the moment center of the balance at the cg location about which the aerodynamic moments are desired. Electrical current from the balance, and to the motors on the rig, is passed through slip-rings located at the rig head. Examples of how the rig is positioned for different pitch and roll angles are shown in figures 2a and 2b, respectively.

The model can be rotated up to 90 rpm in either direction. By using different rotational speeds and a specific airflow in the tunnel, the motions of a steady spinning airplane can be simulated. The aerodynamic forces and moments can then be measured for values of $\Omega b/2V$, including the case of $\frac{\Omega b}{2V} = 0$, where static aerodynamic forces and moments can be obtained.

A NASA six-component strain gauge balance is mounted inside the model and measures the normal, lateral and longitudinal forces and the roll, pitch and yaw moments acting about the model body axis. The interactions that exist between the six components are available from balance calibration tests and are accounted for before the balance voltages are converted to forces and moments. The specific balance was chosen on the basis that the maximum loads measured would be toward the upper load limit of each component of the balance.

The data acquisition, reduction and presentation system for the rotary balance system is composed of a 12-channel scanner/voltmeter, a mini-computer and a plotter as shown in figure 3. With this equipment, on-line digital print-out and/or graphical plots of data are possible.

Test Procedures

Rotary aerodynamic data are obtained in two steps. The first step is to record the inertial forces and moments (tares) acting on the model at different attitudes and rotational speeds. To accomplish this, a large box structure is mounted to the lower portion of the rig which encloses the model without touching it. In this manner, the air immediately surrounding the model is rotated

with it. As the rig is rotated at the desired attitude and rpm, the inertial forces and moments generated by the model are measured and stored on magnetic tape for later use.

The second step in the data-gathering process is to measure aerodynamic and inertial forces at different attitudes and rotational speeds for a selected tunnel velocity with, of course, the box structure removed. The tares are subtracted from these values, and the remaining aerodynamic forces and moments are then converted to coefficient form and stored on magnetic tape. The aerodynamic coefficients are plotted versus $\Omega b/2V$ for analysis.

MODEL

A 1/5-scale fiberglass/aluminum model of a configuration considered to be a typical low-wing, single-engine, light general aviation airplane was tested in the present study. A three-view drawing of this model is shown in figure 4, dimensional characteristics of the model are presented in Table I, and a photograph of the model installed on the rotary balance located in the Langley spin tunnel is presented in figure 1.

The model was fabricated such that various airplane components were removable for component build-up tests and for testing alternate wing airfoils and tail configurations. In addition, allowance was made for attaching various fuselage strakes and modifications.

The three wing airfoil sections tested were a modified NACA 64 series airfoil with and without leading-edge droop, and a NASA GA(W)-1 airfoil. Sketches of the airfoils are shown in figure 5. The three tail configurations tested involved different locations of the horizontal tail as shown in figure 6. The fuselage strakes and modifications tested are shown in figures 7 and 8, respectively, and the dimensional characteristics of these fuselage additions are presented in Table II.

Figure 9 and Table II present the location and dimensions, respectively, of spoilers which were tested during this investig-

ation but not during the previous static force test program.

The model control surfaces could be set at any position prior to the test. The maximum deflections for the control surfaces were:

Rudder, deg	25 right, 25 left
Elevator, deg	25 up, 15 down
Aileron, deg	25 up, 20 down

TEST CONDITIONS

The tests were conducted in the spin tunnel during November, 1977 at a tunnel velocity of 7.62 m/sec (25 ft/sec) which corresponds to a R_E of 128,000 based on the model mean aerodynamic chord. Unless noted otherwise in Table III, all the configurations were tested through a pitch angle range of 30 to 90° in 5° increments with the spin axis passing through the full-scale airplane cg location of .255$\bar{c}$ and the roll angle set at 0°. At each spin attitude, measurements were obtained for nominal $\frac{\Omega b}{2V}$ values of .1, .2, .3, .4, .5, .7, and .9 in both clockwise and counterclockwise directions as well as for $\frac{\Omega b}{2V} = 0$ (static value).

DATA PRESENTATION

Table III identifies the configurations tested as well as the figure and page numbers in which the corresponding data are plotted. Each figure presents the aerodynamic coefficients vs $\frac{\Omega b}{2V}$ for various values of pitch angle in the following order: C_n, C_ℓ, C_m, C_N, C_Y. All the moment data are presented for a center of gravity position of 0.255$\bar{c}$.

Table IV lists a key to the configuration nomenclature used in Table III and the data figures.

APPENDIX

As a part of validating the up-dated rotary balance apparatus, a series of tests were performed in which data were measured at a given value for different combinations of linear (V) and angular (Ω) velocities as shown below at θ values of 30, 60 and 90°.

$\frac{\Omega b}{2V}$	LINEAR (TUNNEL) VELOCITY m/sec	ANGULAR (BALANCE) VELOCITY rpm	LINEAR (TUNNEL) VELOCITY m/sec	ANGULAR (BALANCE) VELOCITY rpm	LINEAR (TUNNEL) VELOCITY m/sec	ANGULAR (BALANCE) VELOCITY rpm
0	7.62 (25)	0	14.17 (46.5)	0	19.81 (65)	0
±.05		5		9.5		13
±.10		10		18.5		26
±.20		20		37		51
±.30		30		56		77
±.40		40		74		90
±.50		50				
±.70		70				
±.90		90				

The tunnel velocities of 7.62, 14.17 and 19.81 correspond to a R_E of 1.28, 2.31, and 3.34 x 10^5, respectively, based on $\bar{c}$. The forces and moments measured at a given $\frac{\Omega b}{2V}$ value should be identical for any combination of Ω and V if there are:

1) no scale effects,
2) the inertial forces and moments (tares) can be measured accurately through the angular velocity range tested, and
3) the data acquisition and reduction systems are programmed and functioning properly.

The moment and normal force coefficients obtained from these tests are plotted in figures 53, 54 and 55 for θ values of 30, 60 and 90°, respectively. The symmetry in the data obtained be-

tween clockwise and counterclockwise rotations as well as the repeatability and closeness of the data measured for different combinations of Ω and V at a given spin coefficient value were considered indicative of a satisfactory test capability.

The applicability of the rotary balance data measured at a R_E of 1.28×10^5 to represent full-scale airplane characteristics may be determined by examining the longitudinal aerodynamic data obtained at zero rate of rotation with the data obtained at the Ames 12-foot Pressure Tunnel for a R_E of .288 and 3.45×10^6. These data comparisons are presented in figure 56 for C_m and C_N.

It can be seen from the Ames data that above an angle of attack of 30°, the longitudinal aerodynamic characteristics are not significantly influenced by R_E. Good agreement is also shown between the spin and pressure tunnel data.

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1. Burk, Sanger M., Jr.; Bowman, James S., Jr.; White, William: Spin-Tunnel Investigation of the Spinning Characteristics of Typical Single-Engine General Aviation Designs. I - Low-Wing Model A: Effects of Tail Configurations. NASA TP 1009, Sept. 1977.

2. Bihrle, William, Jr.; Barnhart, Billy; Pantason, Paul: Static Aerodynamic Characteristics of a Typical Single-Engine Low-Wing General Aviation Design for an Angle-of-Attack Range of -8 to 90^{o}. NASA CR-2971, 1978.

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4. Irvin, H.B.; and Batson, A.S.: Experiments on a Model of a Single Seater Fighter Aeroplane in Connection with Spinning. R. & M. No. 1184, British A.R.C., 1928.

5. Bamber, M.J.; and Zimmerman, C.H.: The Aerodynamic Forces and Moments Exerted on a Spinning Model of the "NY-1" Airplane as Measured by the Spinning Balance. NACA Rep. 456, 1933.

6. Stone, R.W., Jr.; Burk, S.M., Jr.; and Bihrle, W., Jr.: The Aerodynamic Forces and Moments on a 1/10-Scale Model of a Fighter Airplane in Spinning Attitudes as Measured on a Rotary Balance in the Langley 20-Foot Free-Spinning Tunnel. NACA TN 2181, 1950.

7. Bihrle, W., Jr.; and Barnhart, B.: Effects of Several Factors on Theoretical Predictions of Airplane Spin Characteristics. NASA CR-132521, Aug. 1974.

8. Bihrle, W., Jr.: Correlation Study of Theoretical and Experimental Results for Spin Tests of a 1/10-Scale Radio Control Model. NASA CR-144995, July 1976.

TABLE I.- DIMENSIONAL CHARACTERISTICS OF THE MODEL

Overall length with tail 3, m (ft)	1.17 (3.83)
Wing:	
Span, m (ft)	1.46 (4.80)
Area, m^2 (ft^2)	.36 (3.87)
Root chord, cm (in.)	24.54 (9.66)
Tip chord, cm (in.)	24.54 (9.66)
Mean aerodynamic chord, cm (in.)	24.54 (9.66)
Leading edge of $\bar{c}$, distance rearward of leading edge of root chord, cm (in.)	0
Aspect ratio	5.9
Dihedral, deg	5.0
Incidence:	
Root, deg	3.5
Tip, deg	3.5
Airfoil section	NACA 64_2-415 modified
Horizontal tail:	
Span, m (ft)	.47 (1.53)
Incidence, deg	-3.0
Airfoil section	NACA 65_1-012
Vertical tail:	
Airfoil section	NACA 65_1-012

TABLE II.- DIMENSIONAL CHARACTERISTICS OF MODIFICATIONS

Rounded fuselage corners (C):		
Length, cm (in.)	16.76	(6.60)
Radius, cm (in.)	1.27	(.50)
Strake, horizontal (SH):		
Length, cm (in.)	30.69	(12.08)
Width, cm (in.)	2.29	(.90)
Thickness, cm (in.)	.32	(.13)
Strake, vertical (SV):		
Length, cm (in.)	16.76	(6.60)
Width, cm (in.)	1.35	(.53)
Thickness, cm (in.)	.32	(.13)
Strake, cowl (SC):		
Length, cm (in.)	17.35	(6.83)
Width, cm (in.)	.64	(.25)
Thickness, cm (in.)	.32	(.13)
Ventral fin (U):		
Length, cm (in.)	28.96	(11.40)
Maximum width, cm (in.)	4.57	(1.80)
Thickness, cm (in.)	.32	(.13)
Spoiler (SP):		
Length, cm (in.)	20.32	(8.0)
Width, cm (in.)	3.30	(1.3)

TABLE III.- CONFIGURATIONS TESTED AND FIGURE INDEX

(Unless noted otherwise, all configs. tested with spin axes passing through cg and $\phi = 0^{\circ}$ through $\theta = 30$ to 90° in 5° increments.)

Figure No.	Page No.	CONFIGURATION	δ_e deg	δ_a deg	δ_r deg	ϕ deg	SR	REMARKS
10	27	BW1H6V	0	0	0	0	0	
11	37					10		
12	47					-10		
13	57					-5		
14	67					0	15.24F	$\theta = 15$ to 60° only
15	77		-25				0	$\theta = 50$ to 90° only
16	82				-25			$\theta = 30$ to 70° only
17	87		15		0			$\theta = 50$ to 90° only
18	92				-25			$\theta = 50$ to 90° only
19	97	BW1H3V	0		0			
20	107					10		
21	117		-25			0		
22	127				25			
23	137				-25			
24	147			-22.5				
25	157			22.5				
26	167			-22.5	0			
27	177		15	0				
28	187	BW1H5V	0			0		
29	197				-25			
30	207	BW1HVTT			0			
31	217	BW2H3V						
32	227				-25			
33	237	BW3H3V			0			
34	247	BW1H4V						
35	257	+C						
36	267	+SH						
37	277	+SV						
38	287	+SC						
39	297	+U						
40	307	+D						
41	317	+E						
42	327	+SP1						θ measured in 10° increments
43	337	+½SP1						" " " " "
44	347	+SP2						" " " " "
45	357	BH3V						
46	367	BH4V						
47	377	BW1H3						
48	387	BW1V						
49	397	BW1						
50	407	BH3						$\theta = 60$ to 90° only
51	412	BV						
52	422	B						

TABLE IV.- CONFIGURATION NOTATION

B	Fuselage
W1	Modified NACA 64_2 - 415 airfoil
W2	NASA GA(W) - 1 airfoil
W3	Modified NACA 64_2 - 415 airfoil with leading-edge droop
H3	Horizontal tail #3
H4	Horizontal tail #4
H5	Horizontal tail #5
H6	Horizontal tail #6
TT	Twin tail
V	Vertical tail
C	Rounded fuselage corners
SH	Horizontal fuselage strakes
SV	Vertical fuselage strakes
SC	Cowl strakes
U	Ventral fin
E	Extended fuselage
D	Deep rounded fuselage bottom
SP1	Spoiler (position 1)
SP2	Spoiler (position 2)
½SP1	Spoiler (position 1 on one wing)

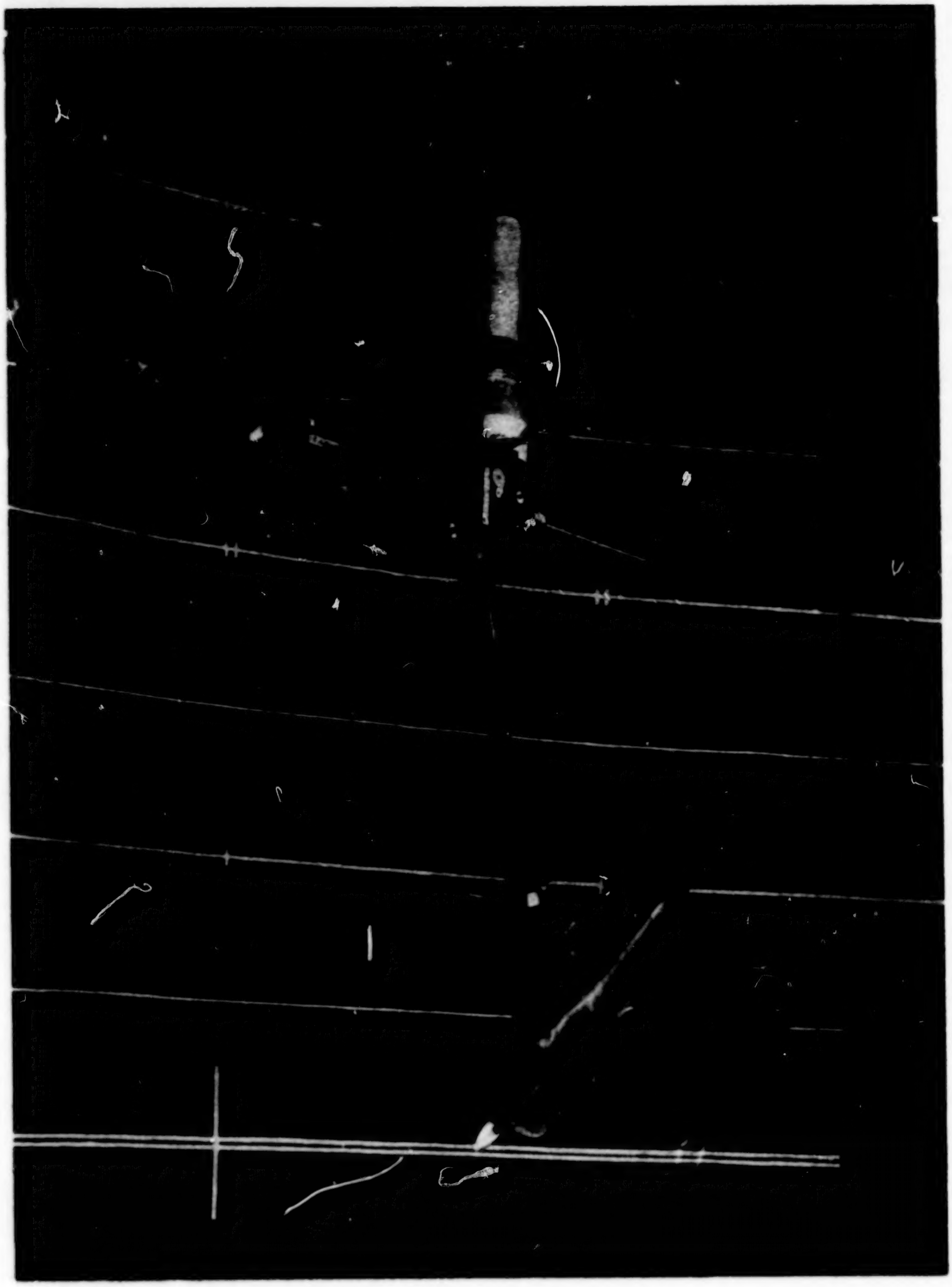
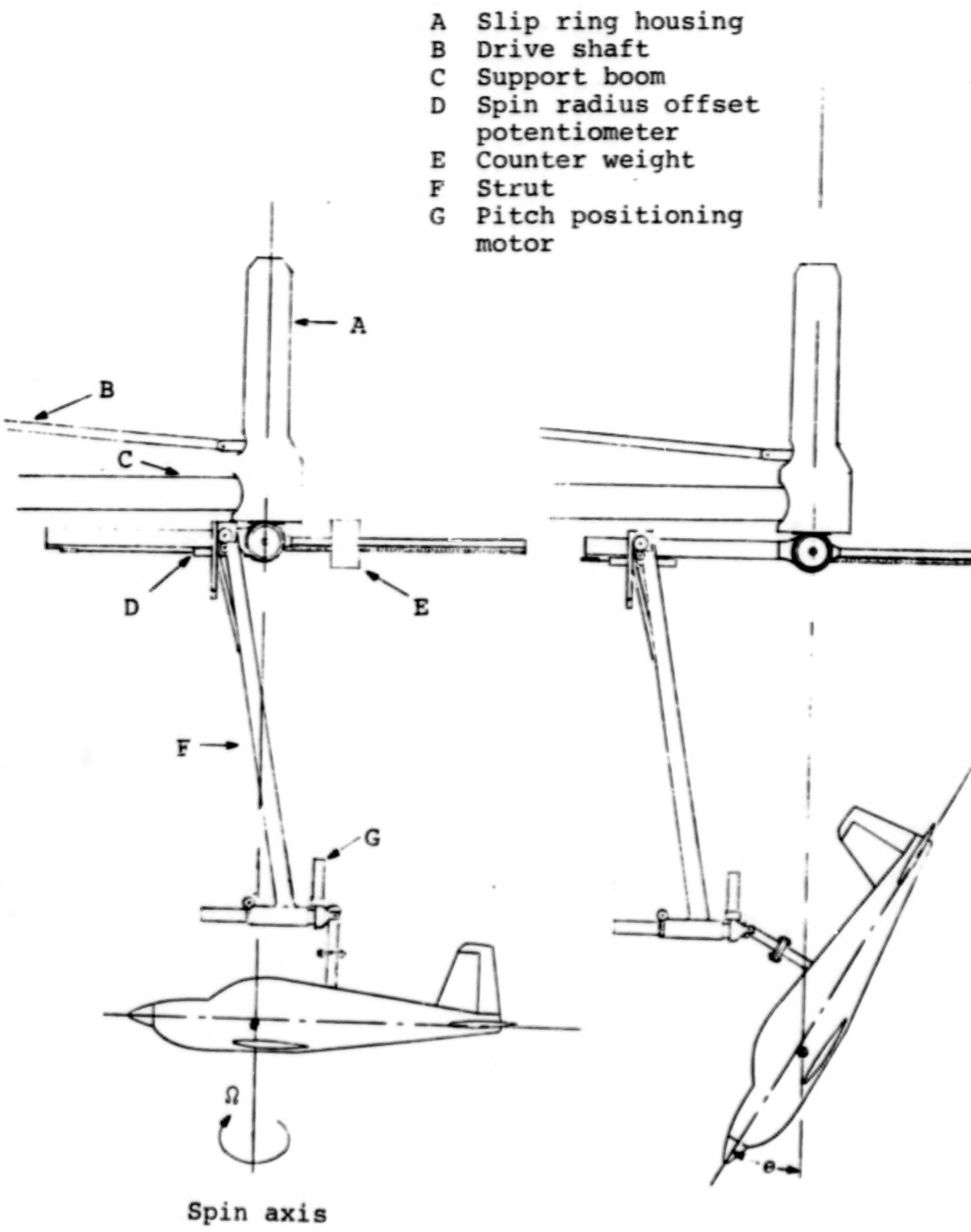
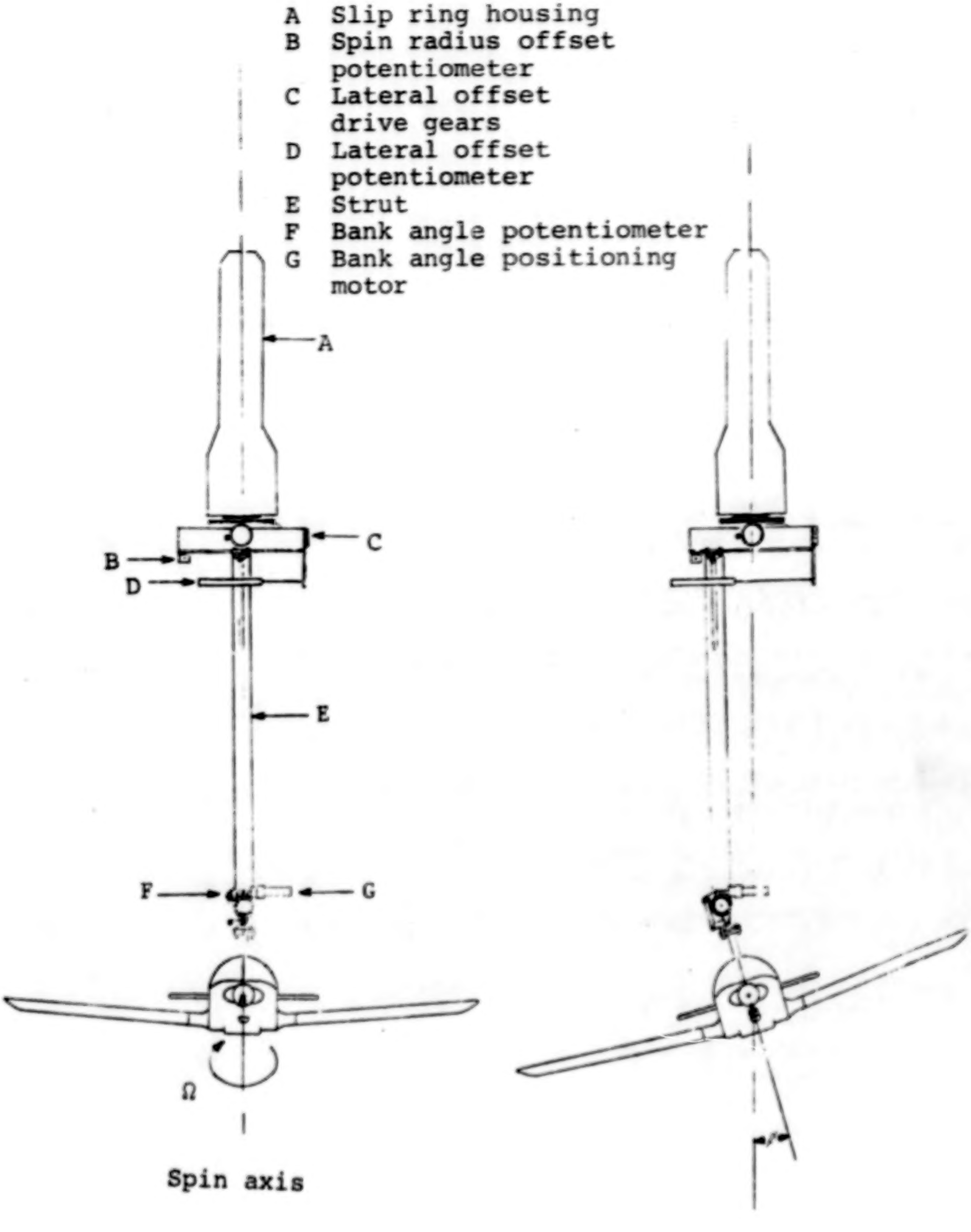


Figure 1.- Photograph of 1/5-scale model installed on rotary balance apparatus.



a) Side view of model

Figure 2.- Sketch of rotary balance apparatus.



b) Front view of model.

Figure 2.- Concluded.

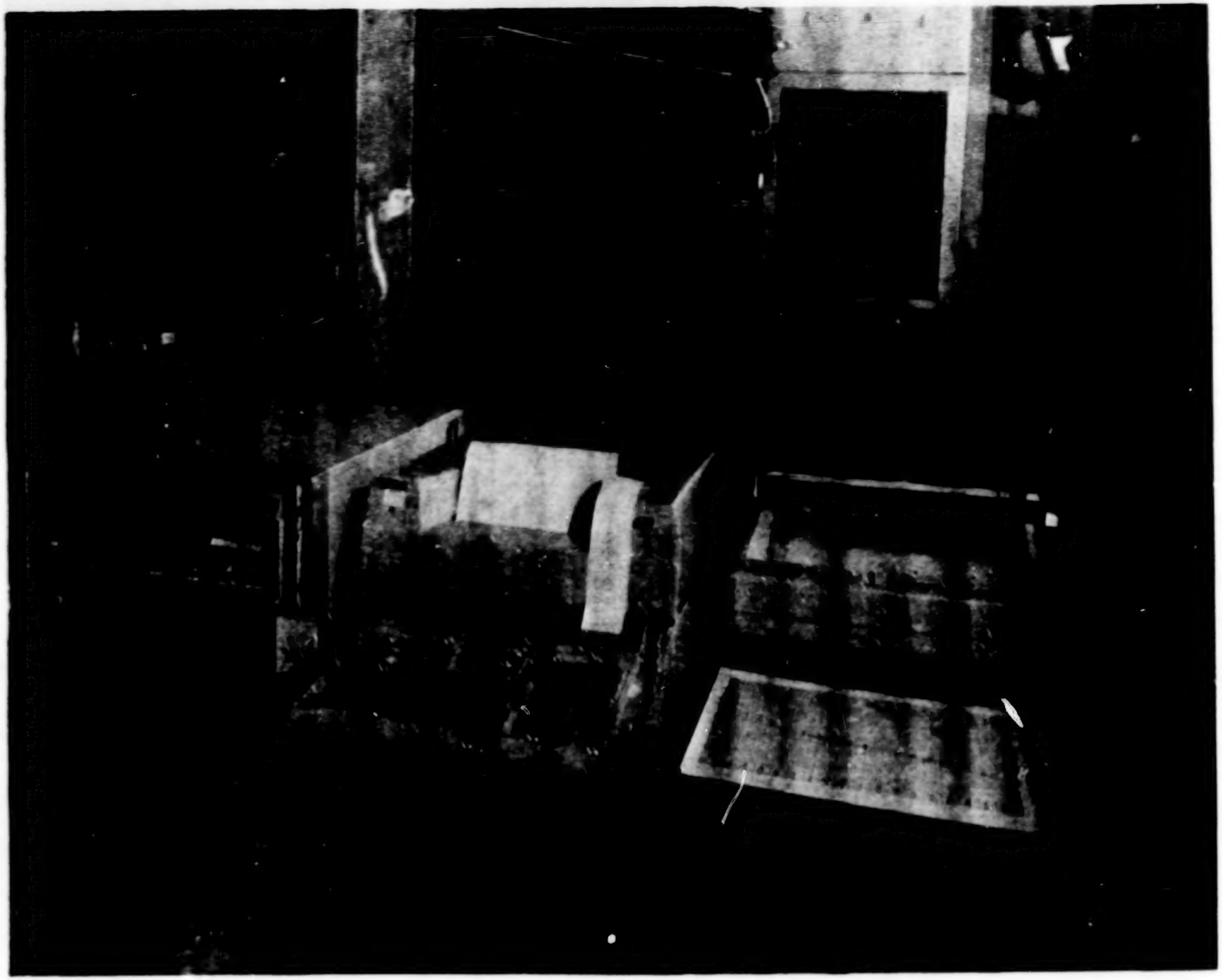


Figure 3.- Photograph of on-line rotary balance data acquisition, reduction and presentation set-up.

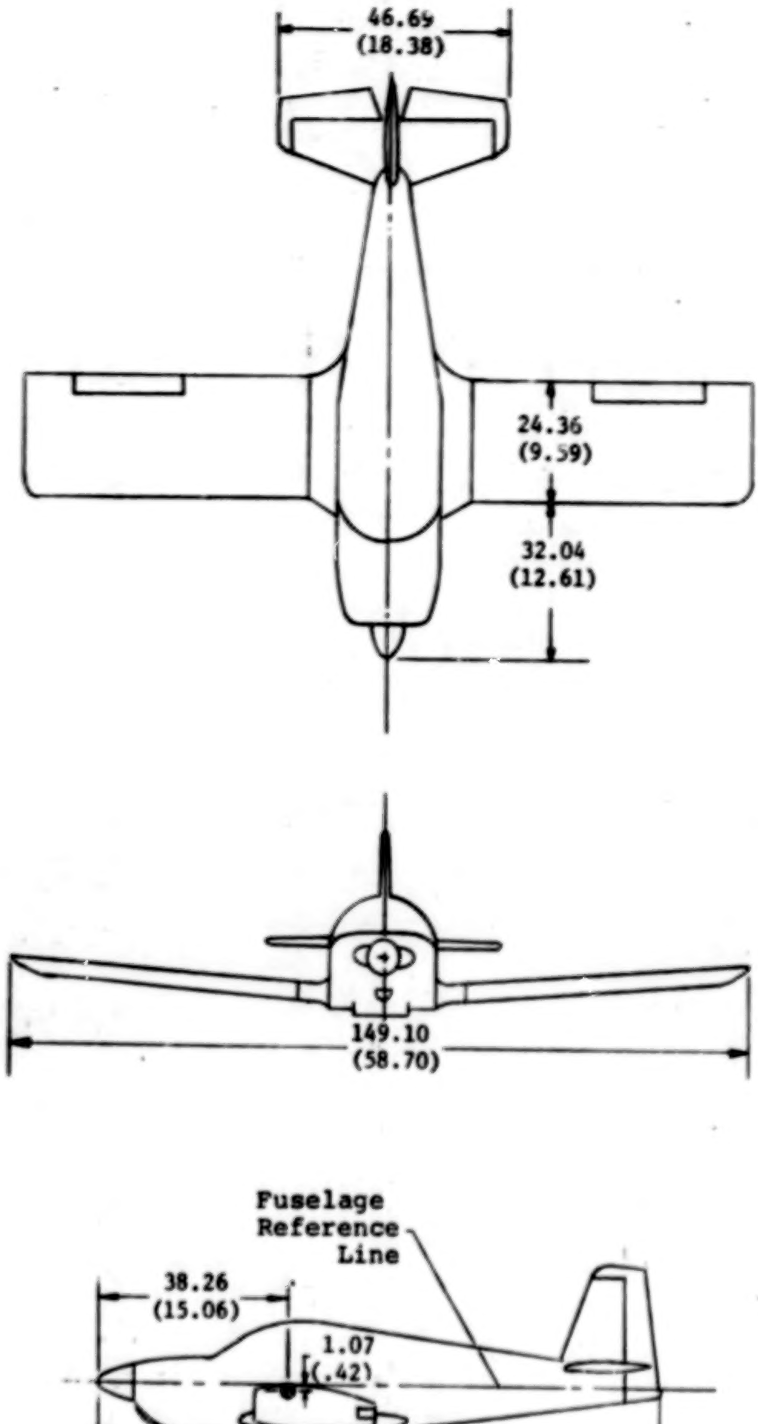


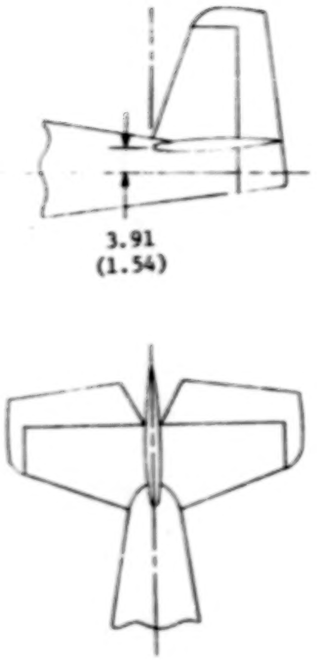
Figure 4.- Three-view drawing of 1/5-scale low-wing general aviation model with tail 3 illustrated. Center-of-gravity positioned at 0.255c̄. Dimensions are given in centimeters (inches), model scale.

NASA GA(W) -1 airfoil

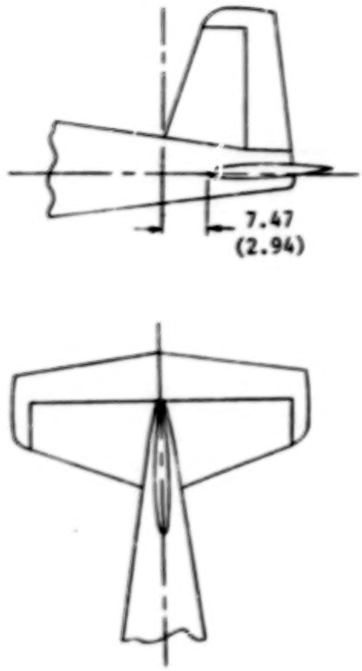
Modified NACA 64_2 - 415 airfoil with leading-edge droop.

Modified NACA 64_2- 415 airfoil

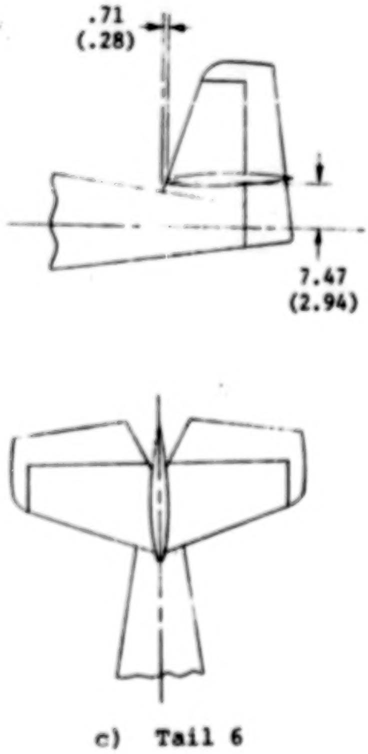
Figure 5.- Wing airfoil sections tested on model.



a) Tail 3

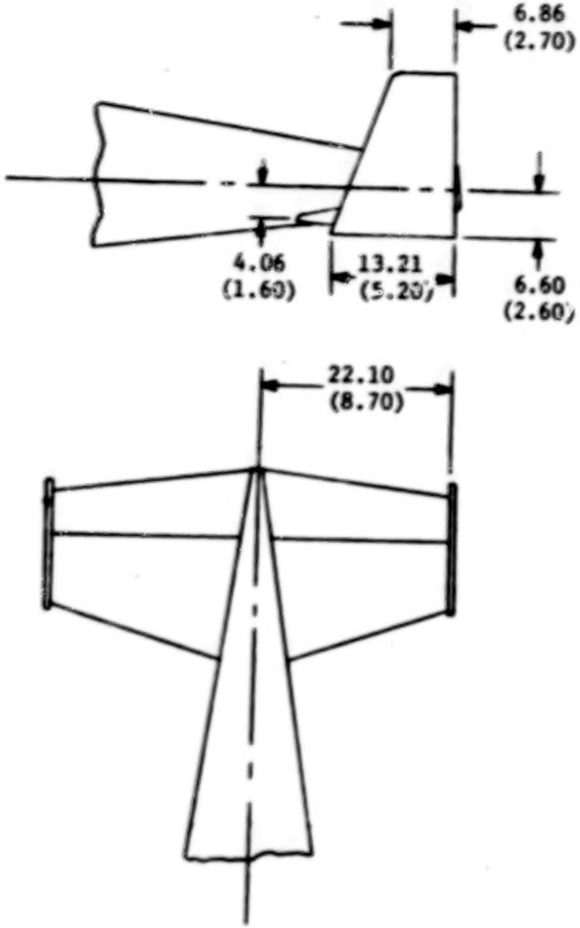


b) Tail 4

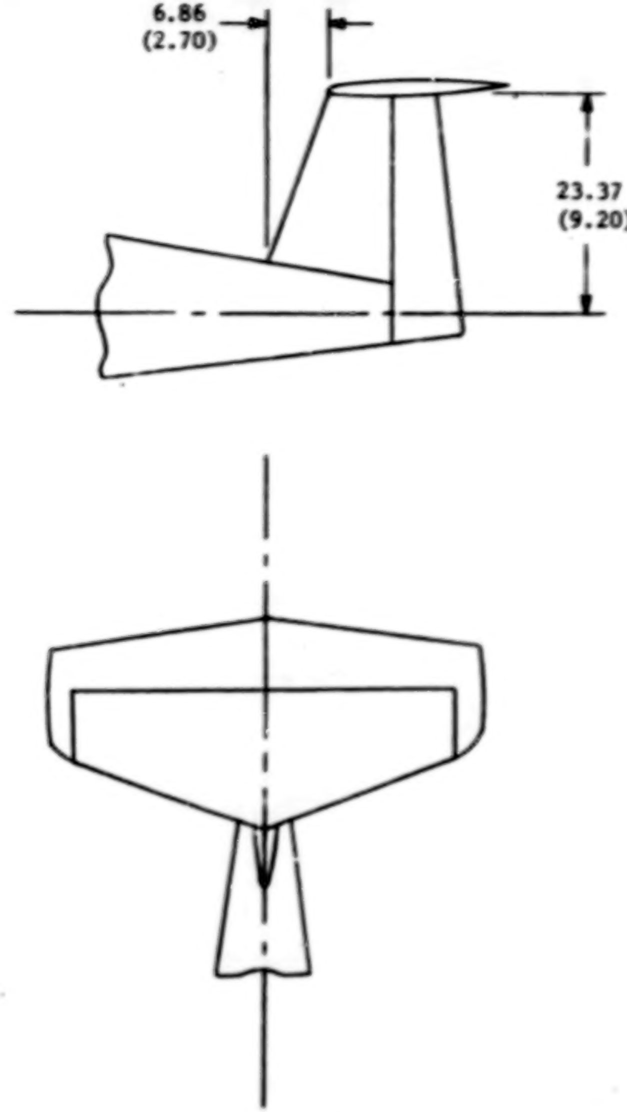


c) Tail 6

Figure 6.- Tail configurations tested on model. Dimensions are given in centimeters (inches), model scale.

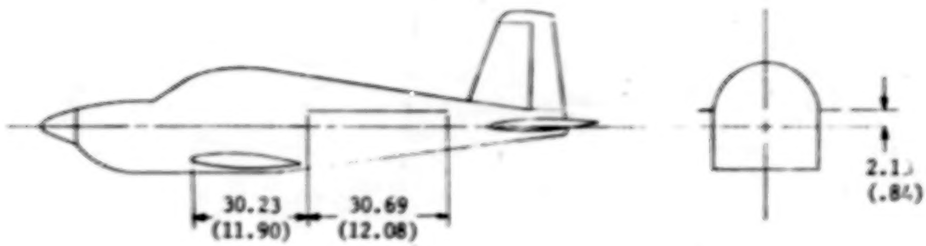


d) Twin tail

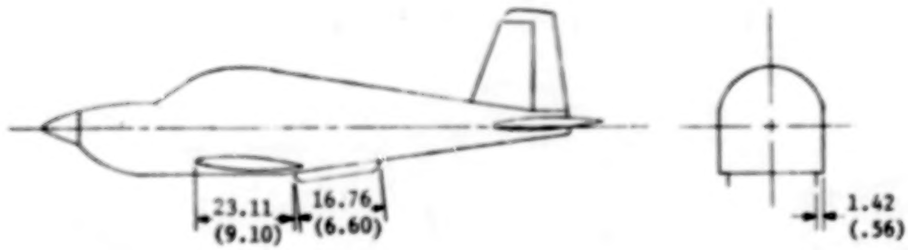


e) Tail 5

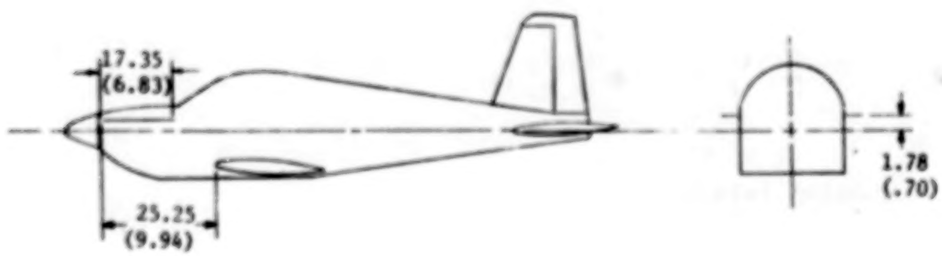
Figure 6.- Concluded.



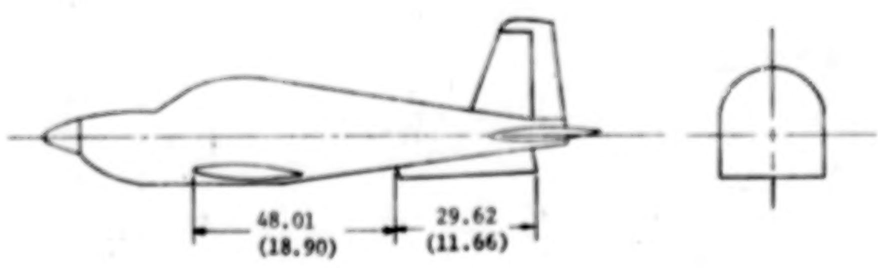
a) Horizontal strakes on fuselage sides.



b) Vertical strakes on fuselage bottom.

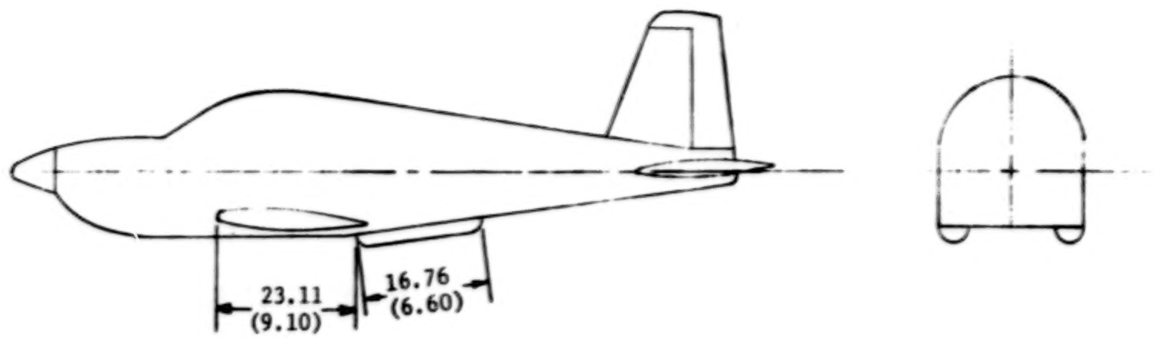


c) Ccwl strakes on fuselage sides.

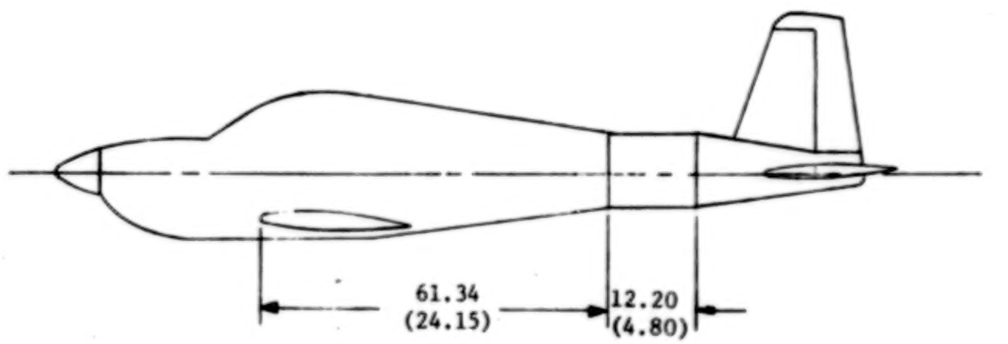


d) Ventral fin on fuselage bottom.

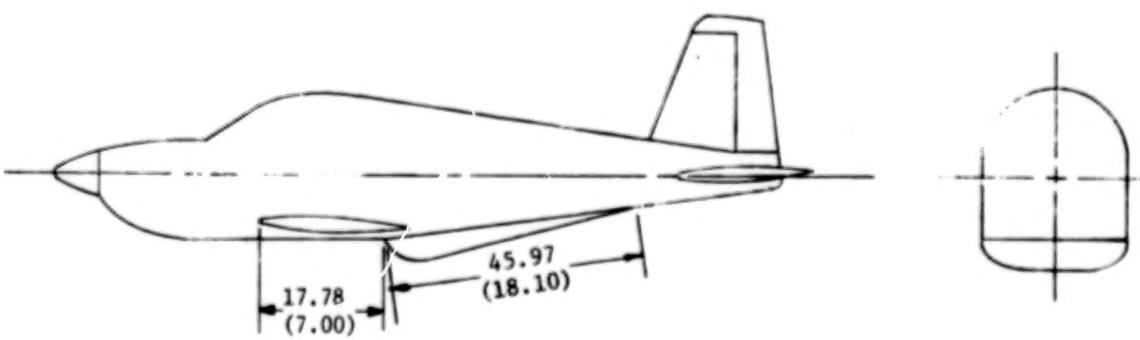
Figure 7.- Fuselage strakes and ventral fin tested on model. Dimensions are given in centimeters (inches), model scale.



a) Rounded fuselage corners (cylinders).



b) Extended fuselage.



c) Deep rounded fuselage bottom.

Figure 8.- Fuselage modifications tested on model. Dimensions are given in centimeters (inches), model scale.

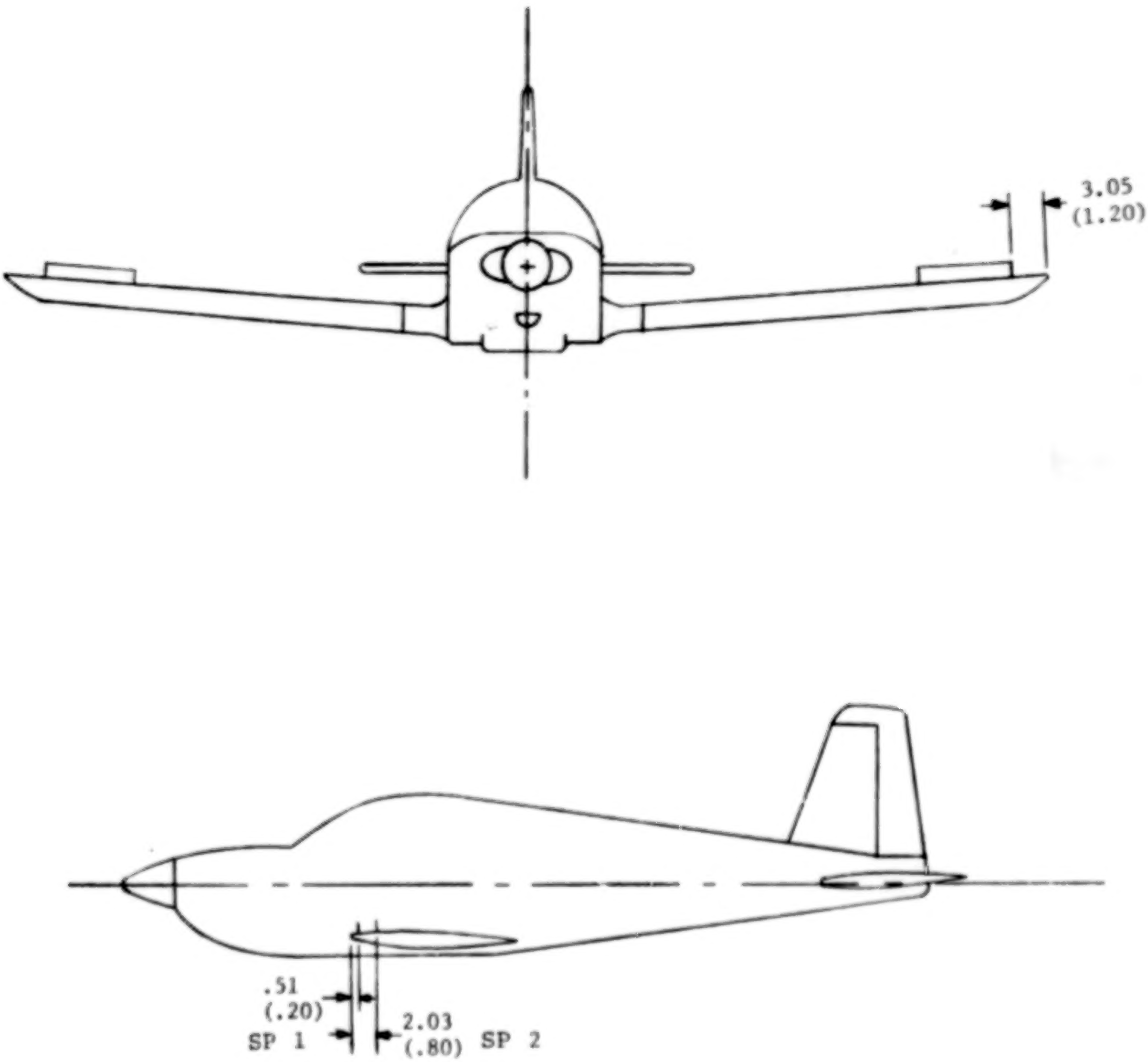
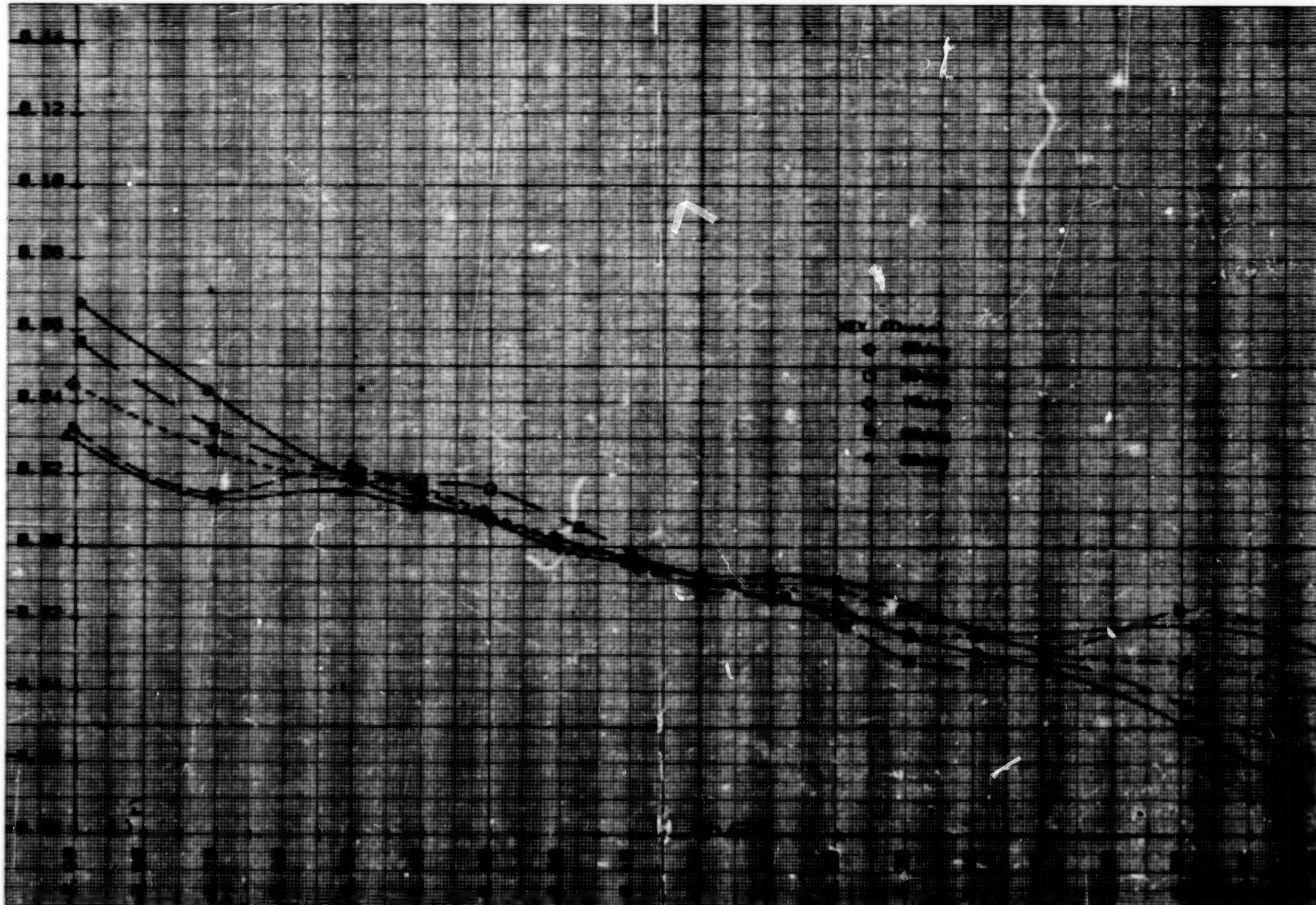
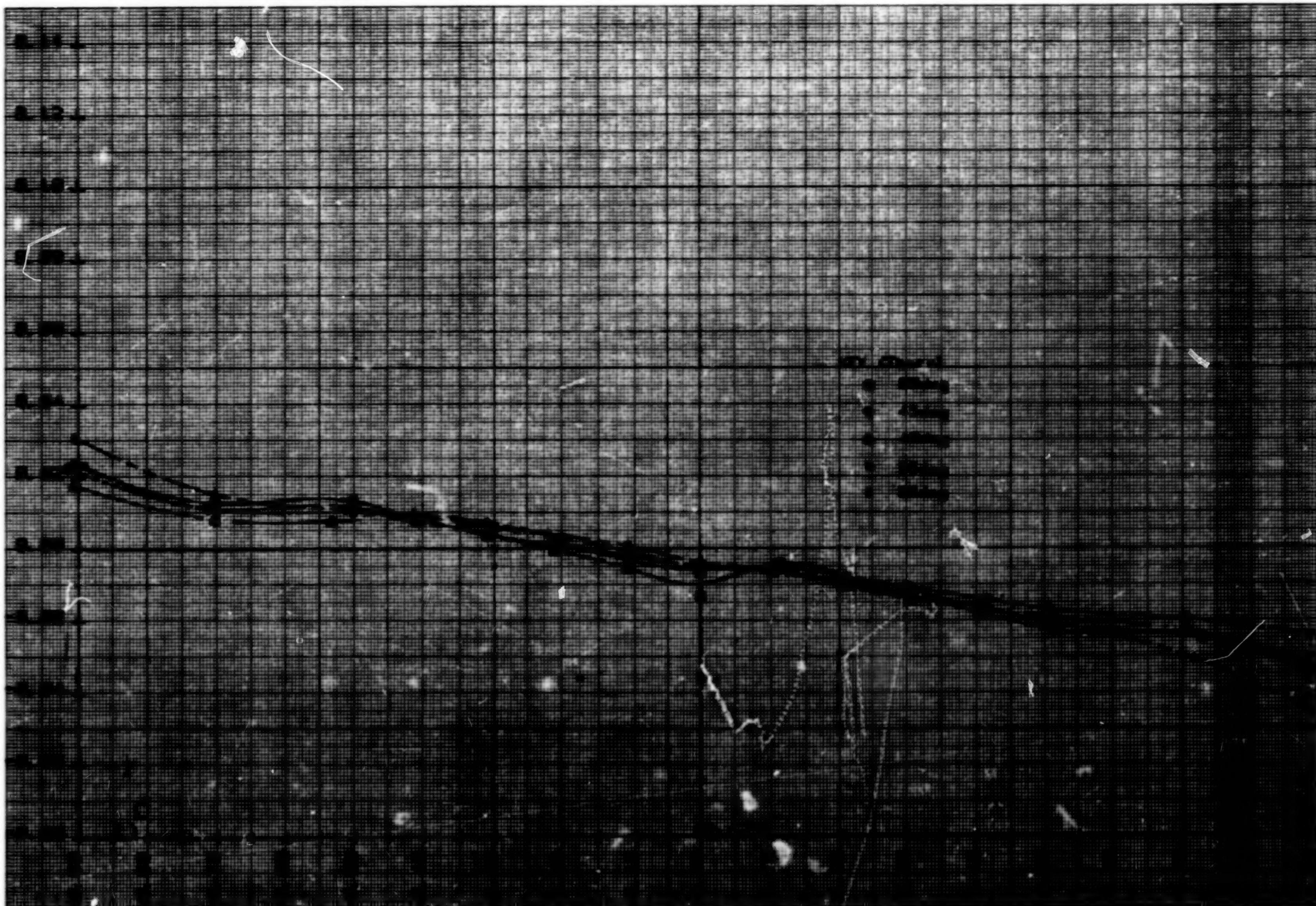


Figure 9.- Location of spoilers tested on model. Dimensions are given in centimeters (inches), model scale.



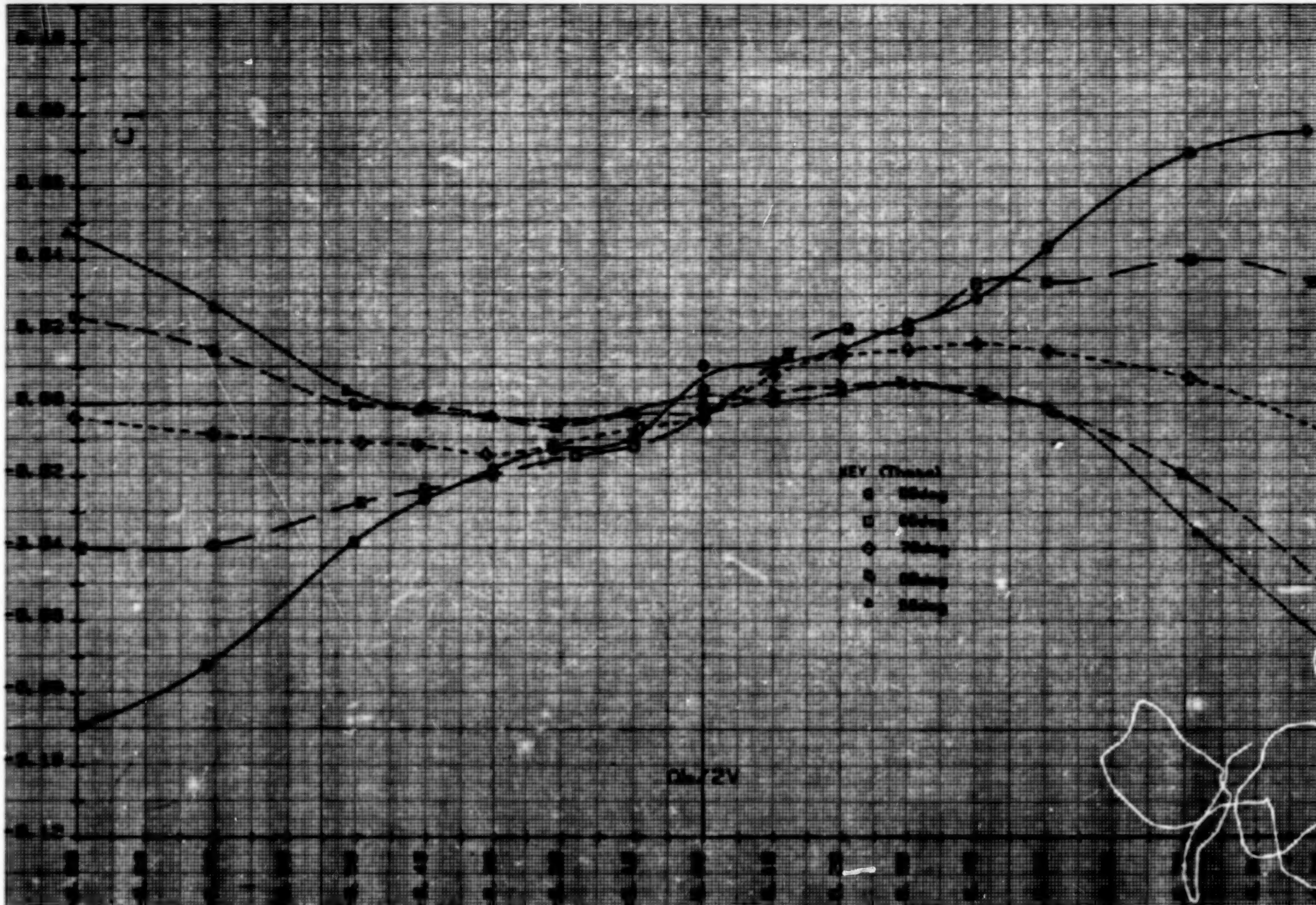
a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 10. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0 2deg.

Figure 10. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 10.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.

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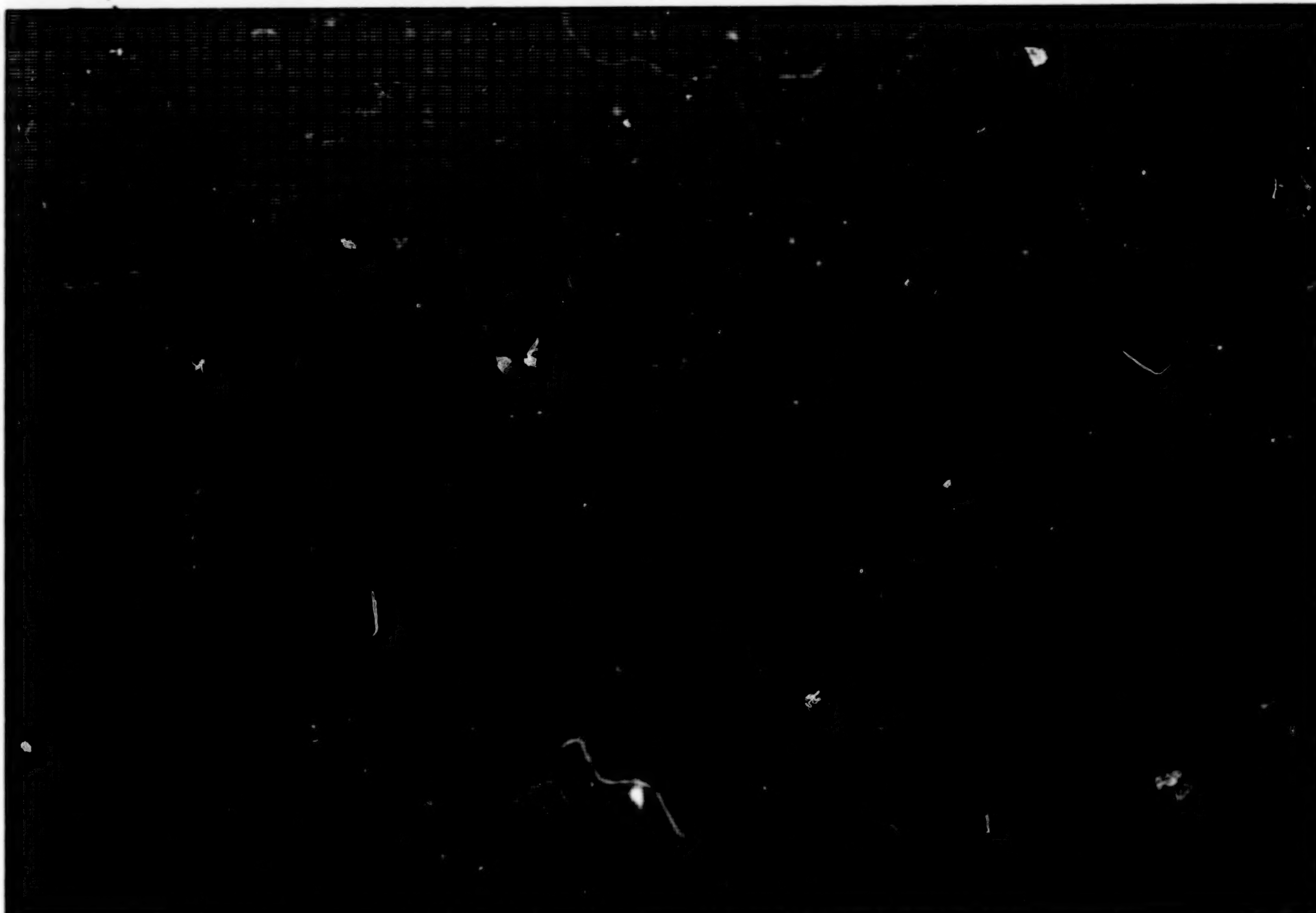
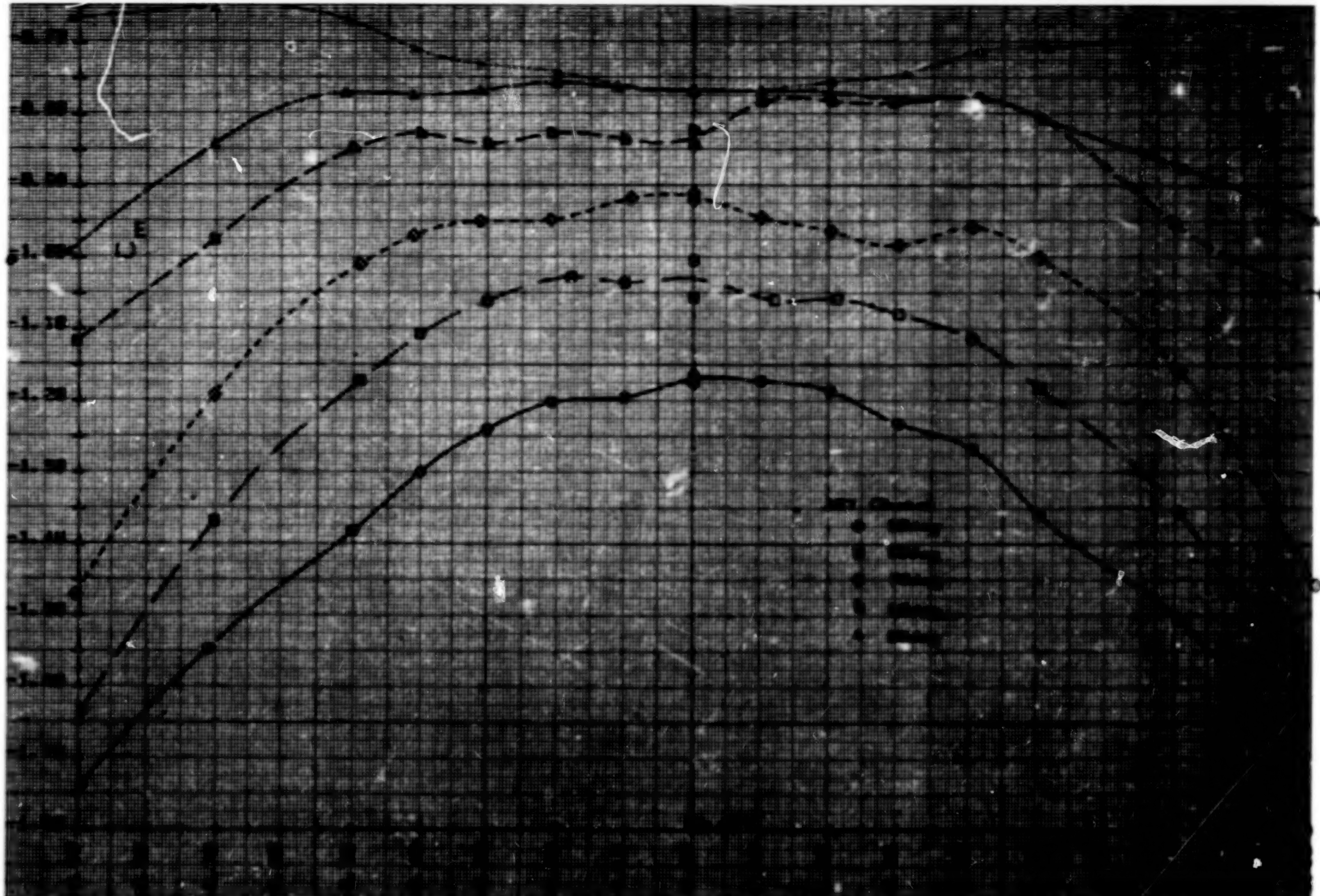


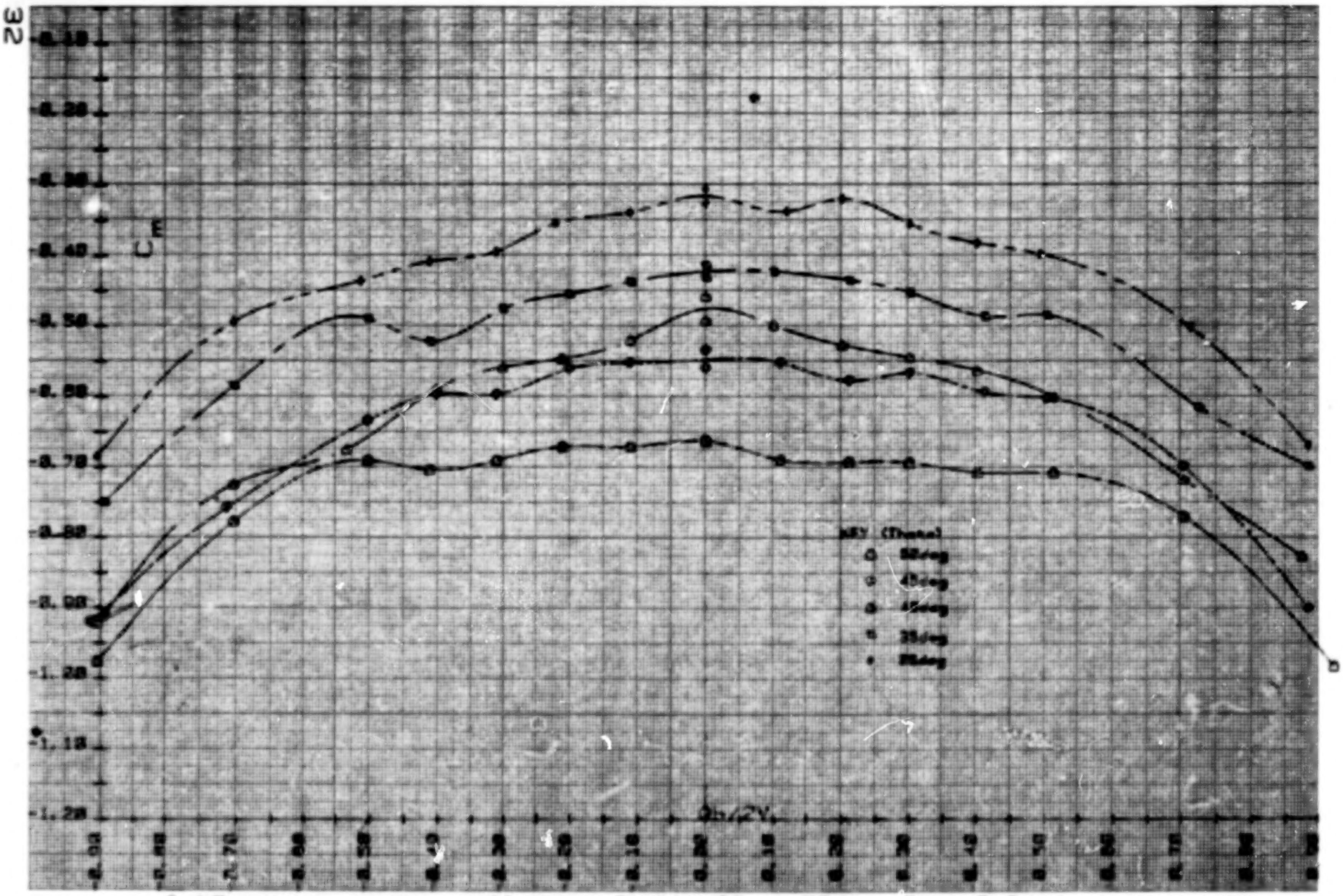
d.)Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

Figure 10.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



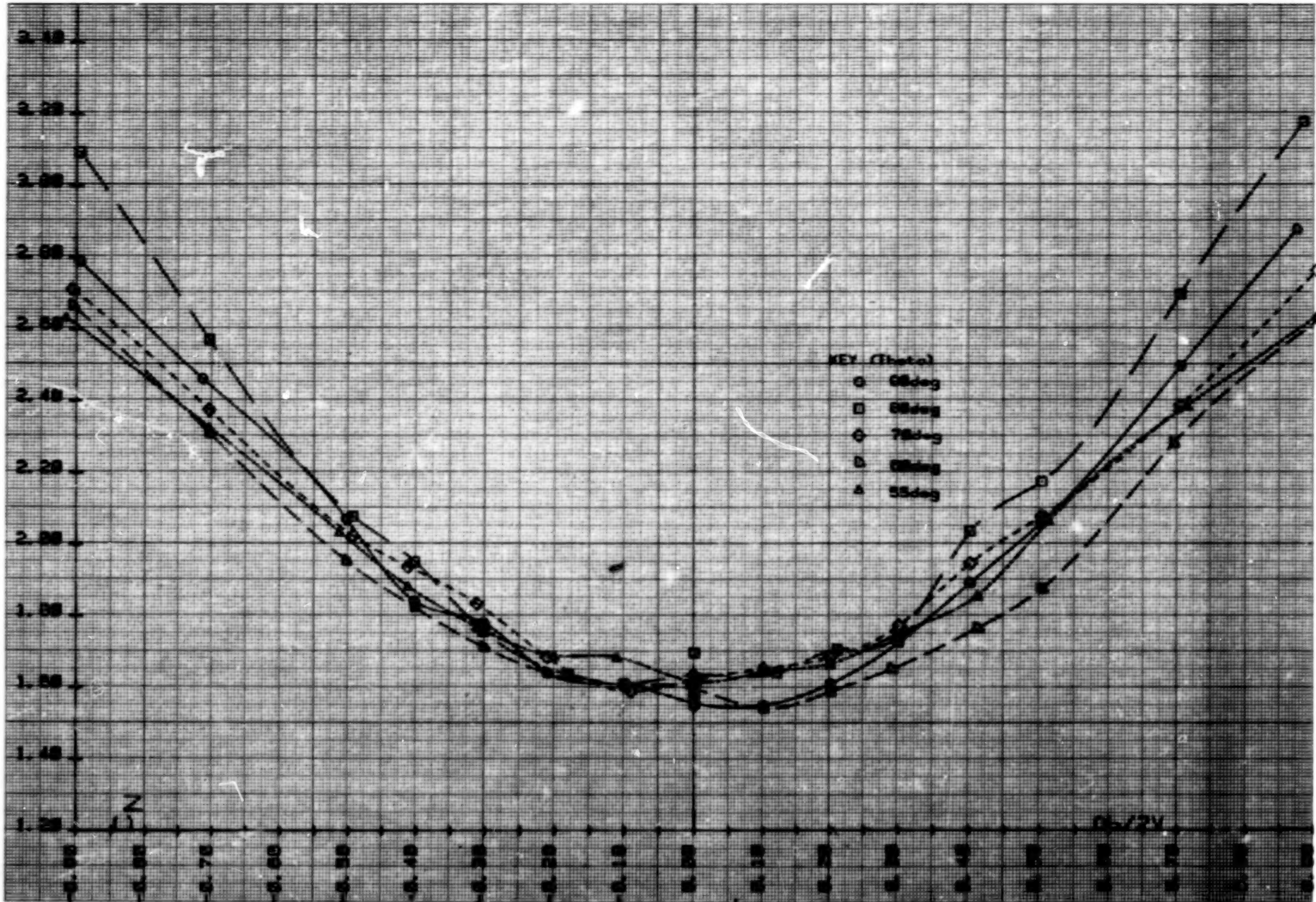
a.)Pitching-moment coefficient. Theta= 55 to 90deg; Phi=-0.4deg.

Figure 10.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



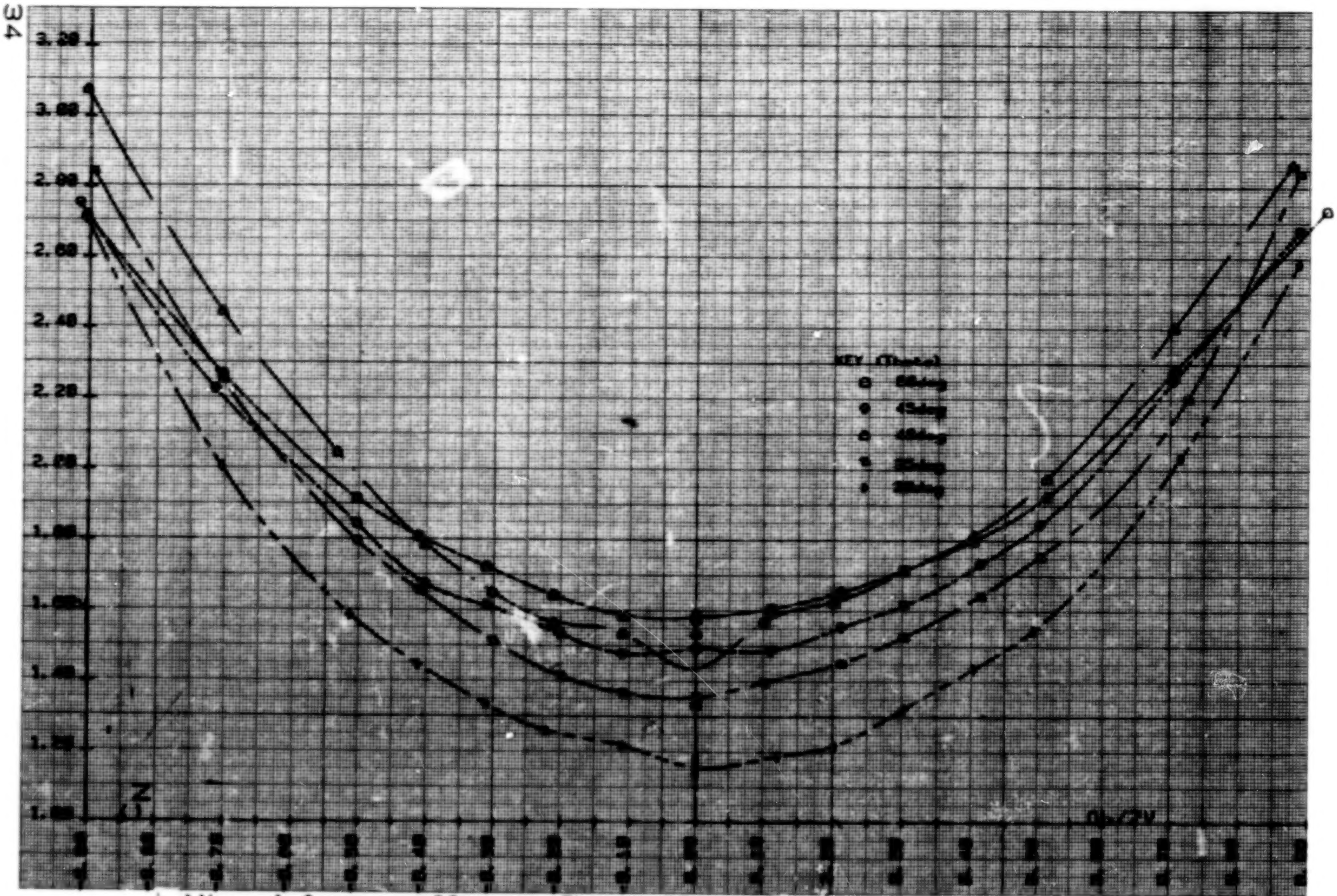
f.) Pitching-moment coefficient. Theta= 30 to 50deg; Phi=-0.2deg.

Figure 10 .-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



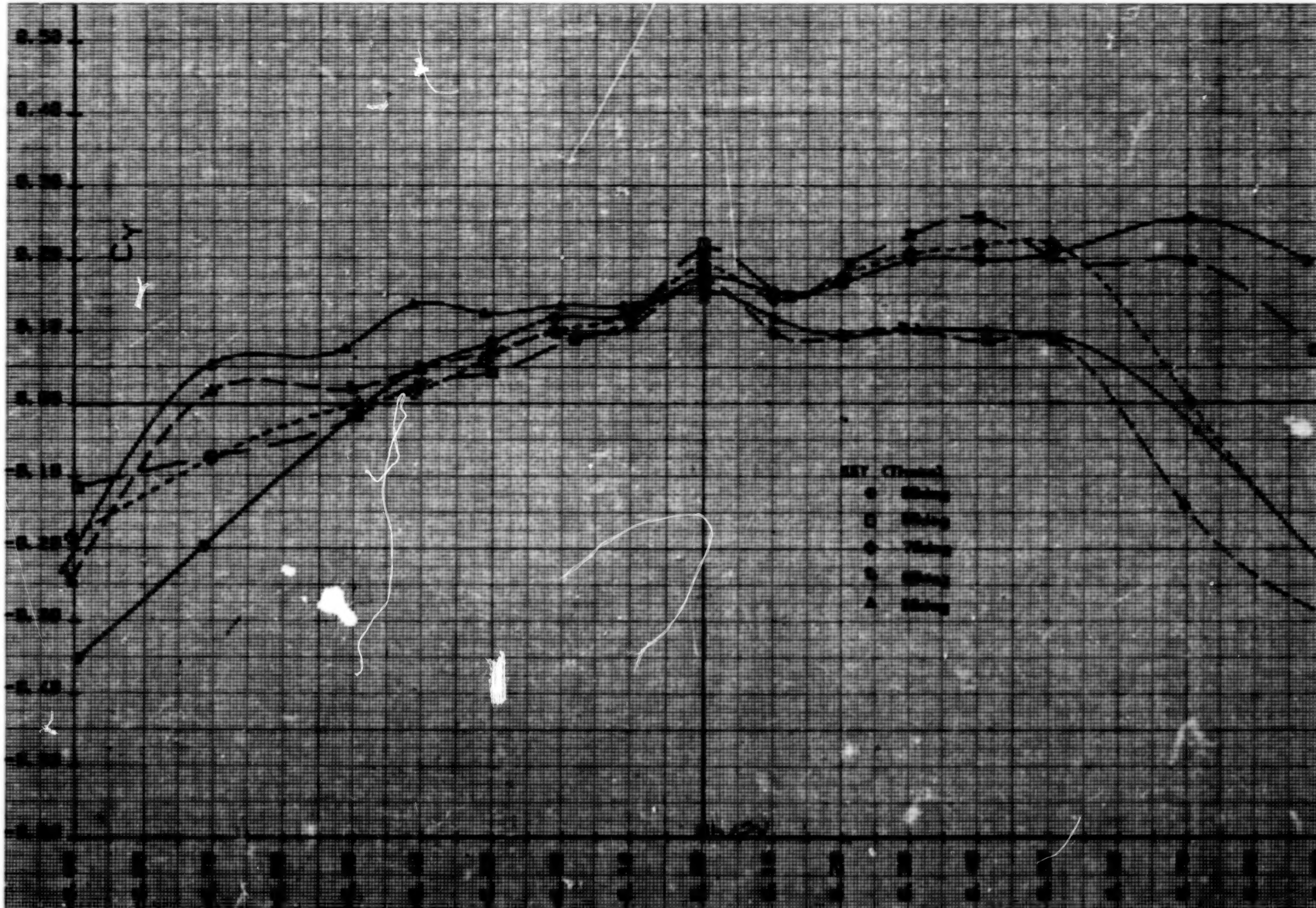
g.) Normal-force coefficient, Theta= 55 to 90deg: Phi=-0.2deg.

Figure 10.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



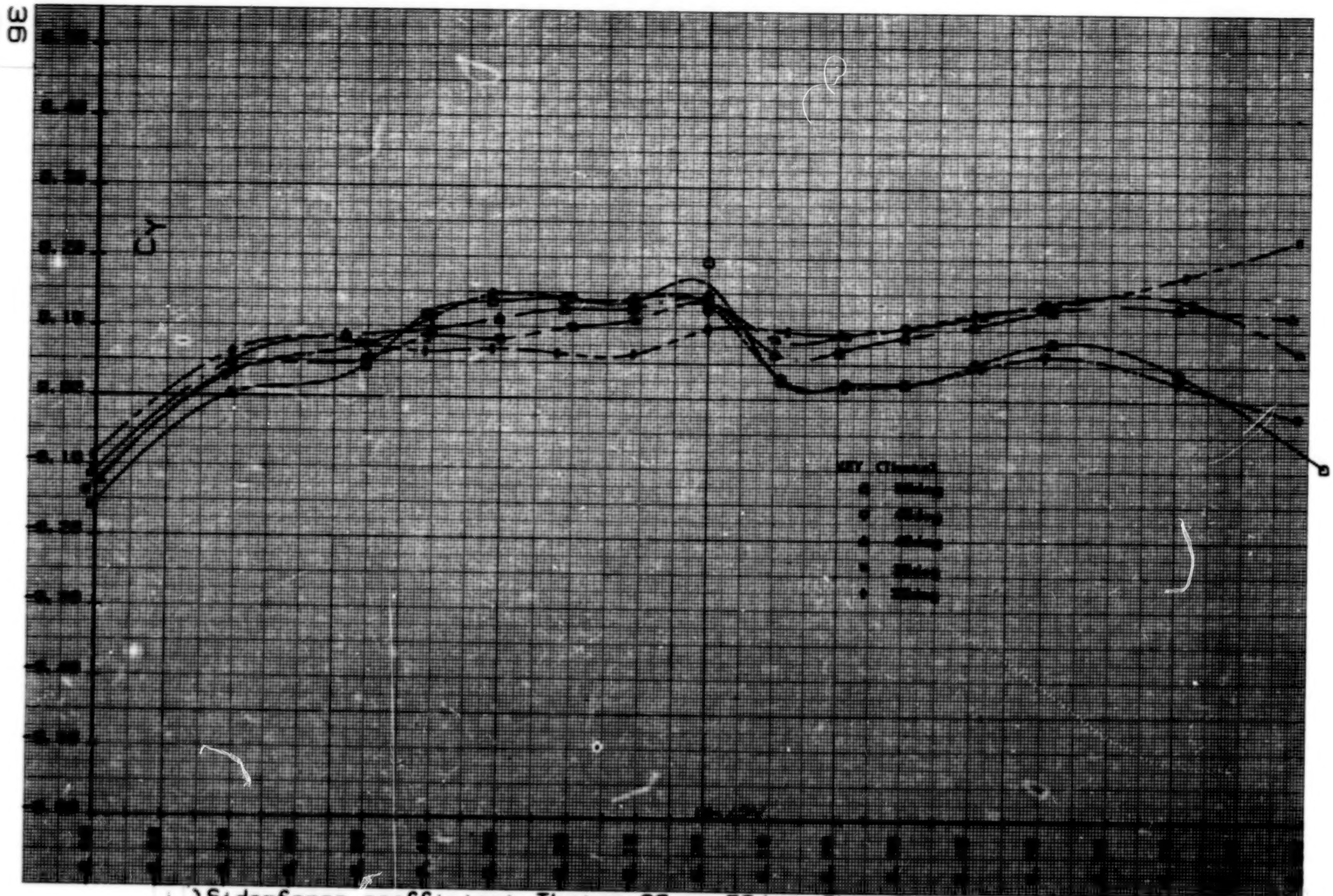
h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 10. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



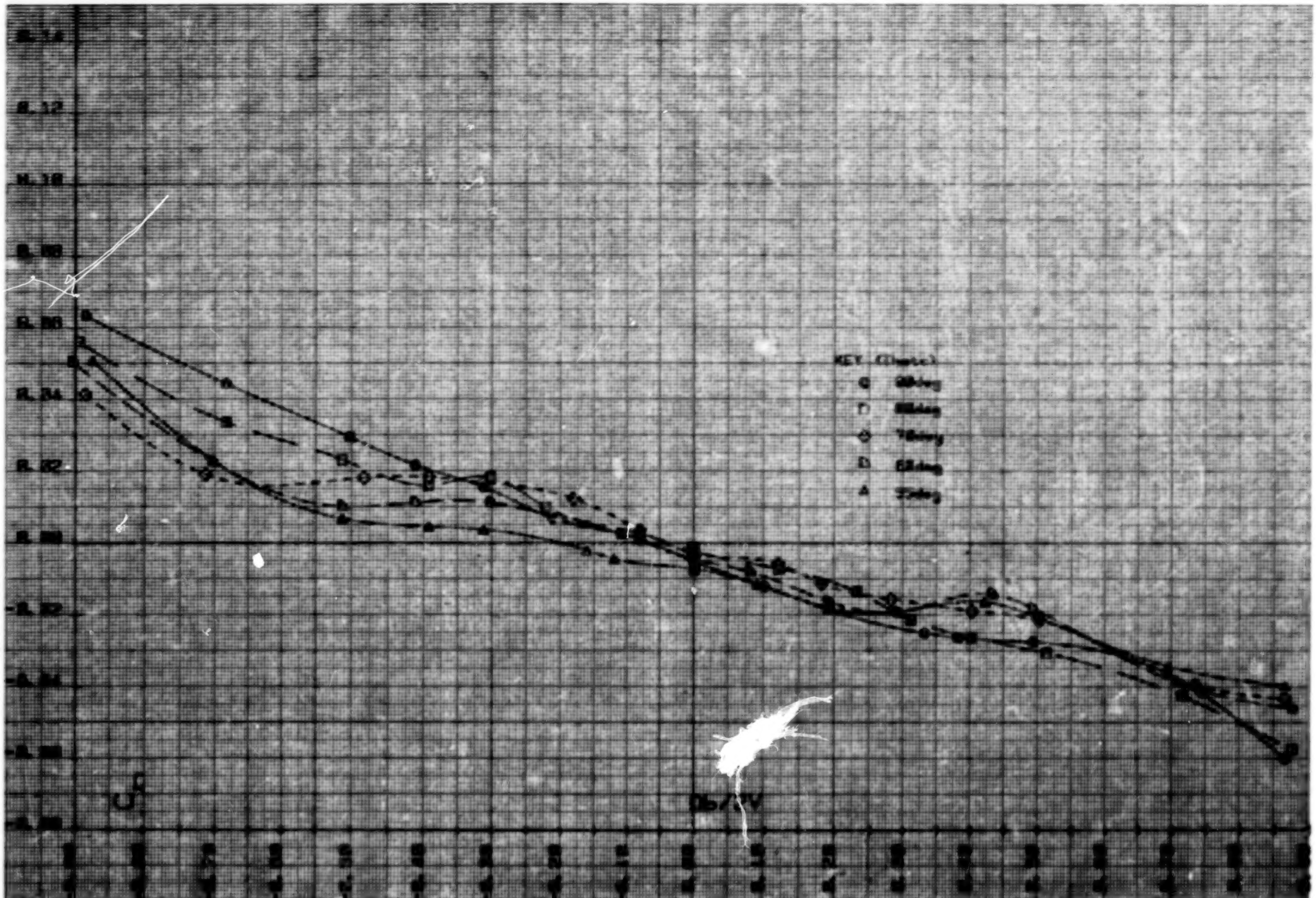
i.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 10.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



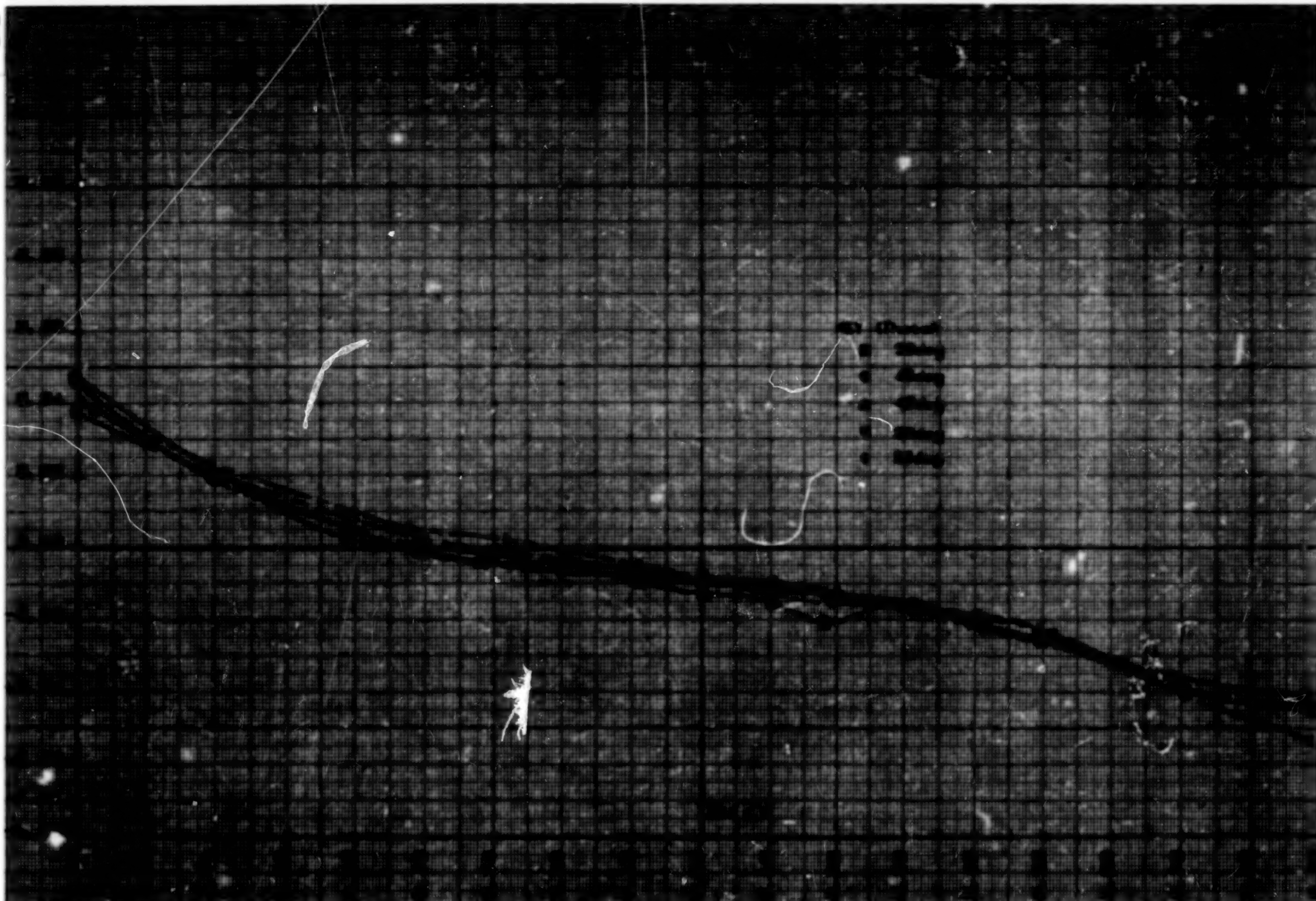
j.) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

Figure 10.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



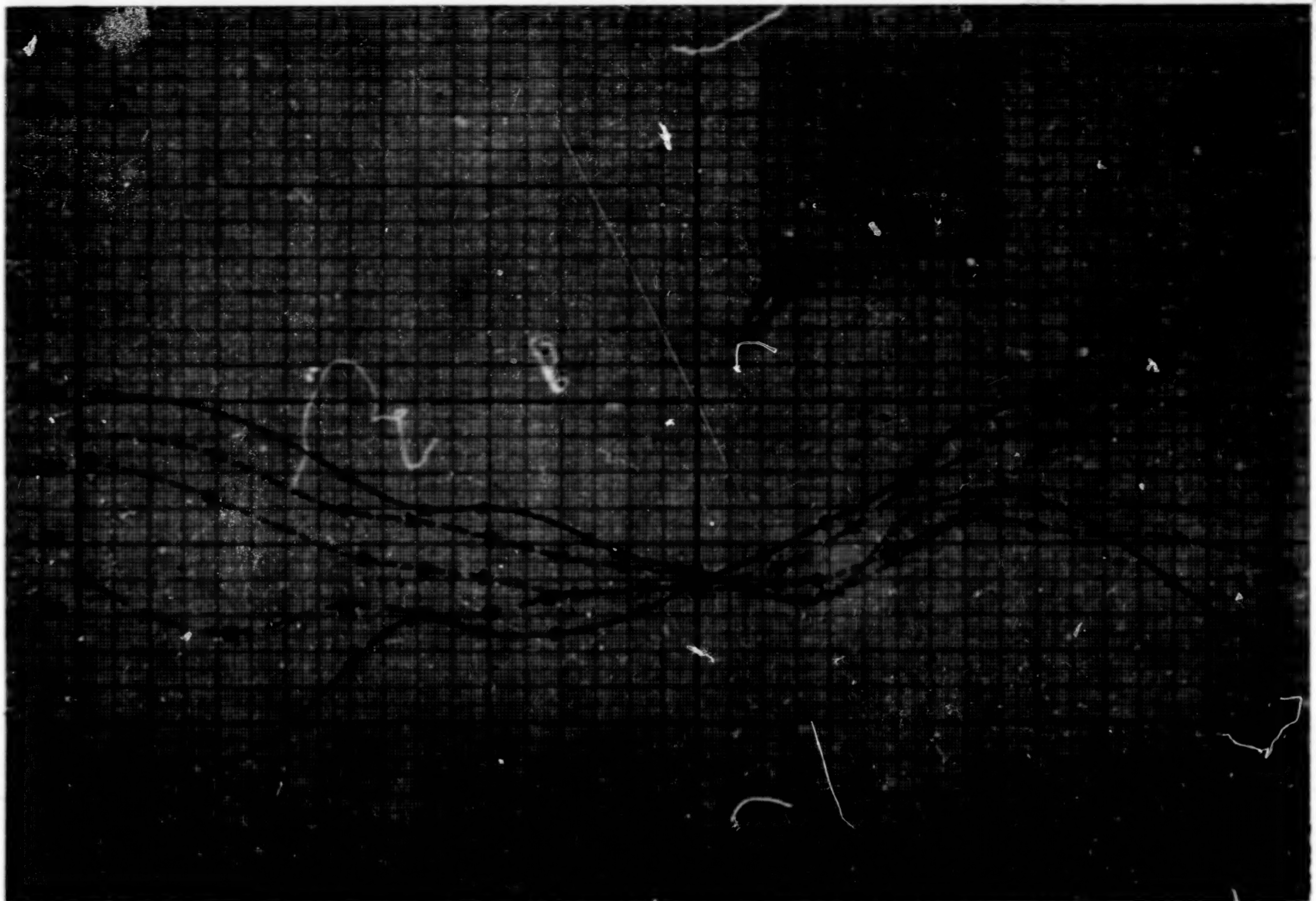
a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi= 10.7deg.

Figure 11.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



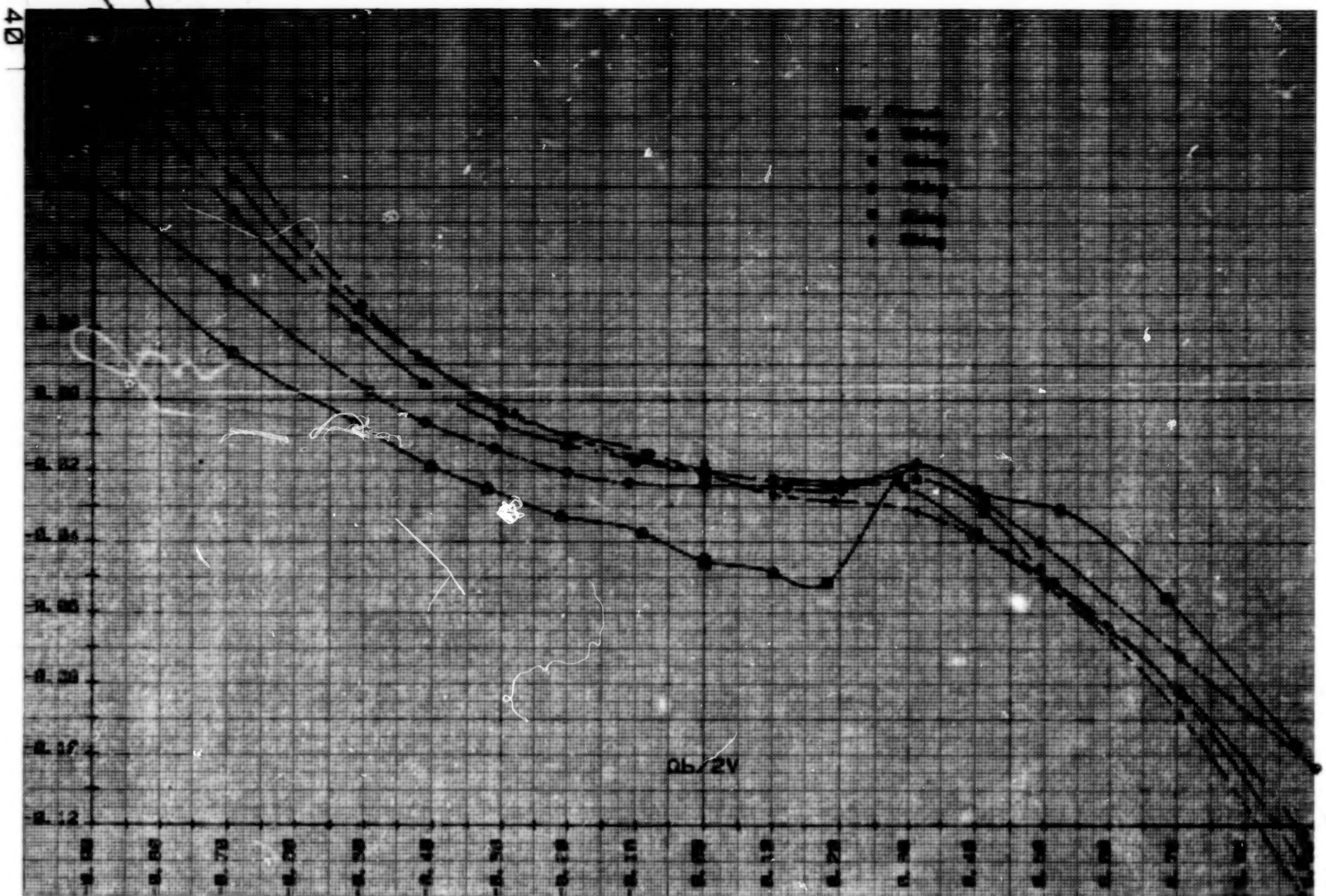
b.) Yawing-moment coefficient. Theta= 30 to 50deg; Phi= 10.8deg.

Figure 11.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



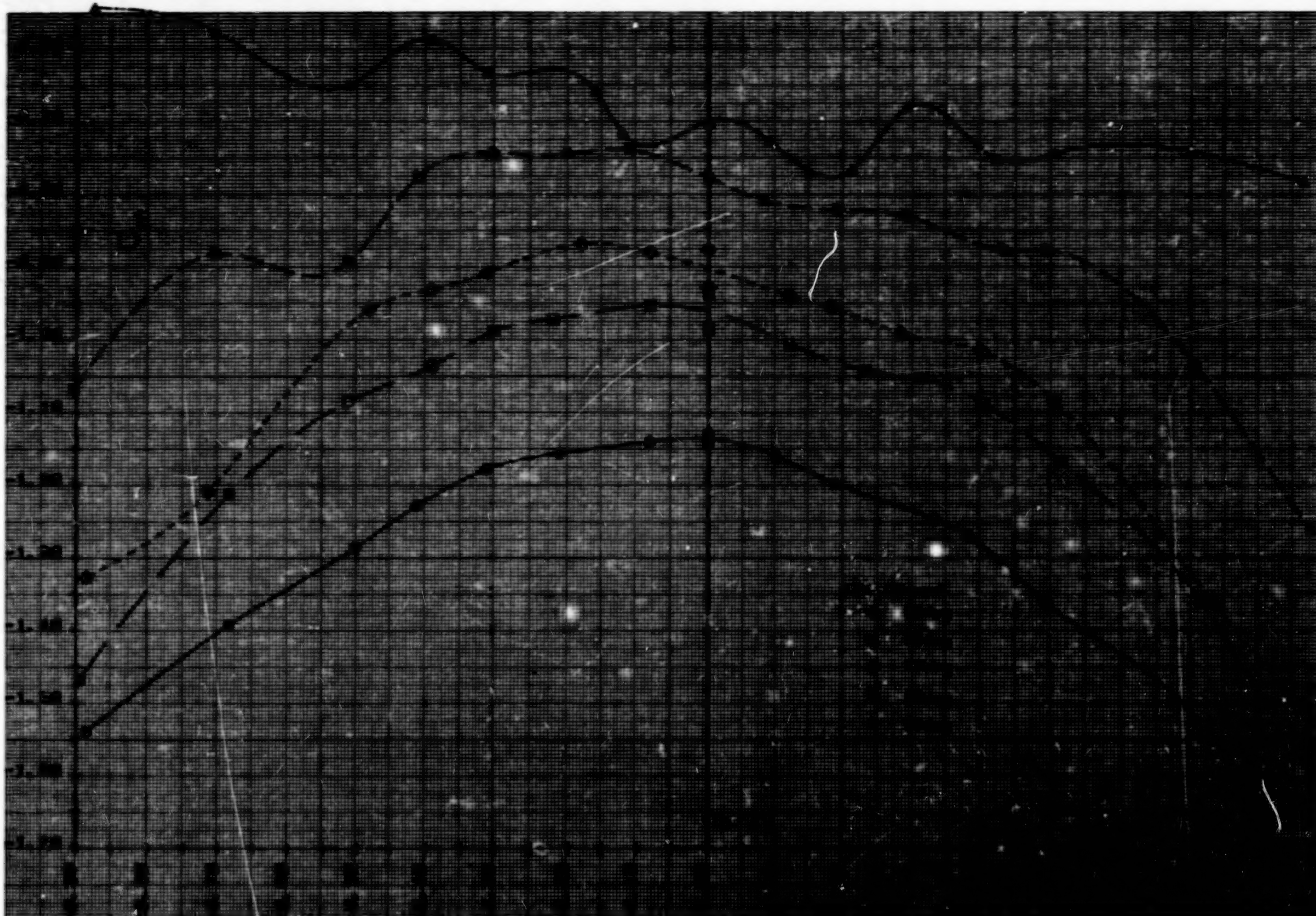
c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi= 10.6deg.

Figure 11.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H8V.



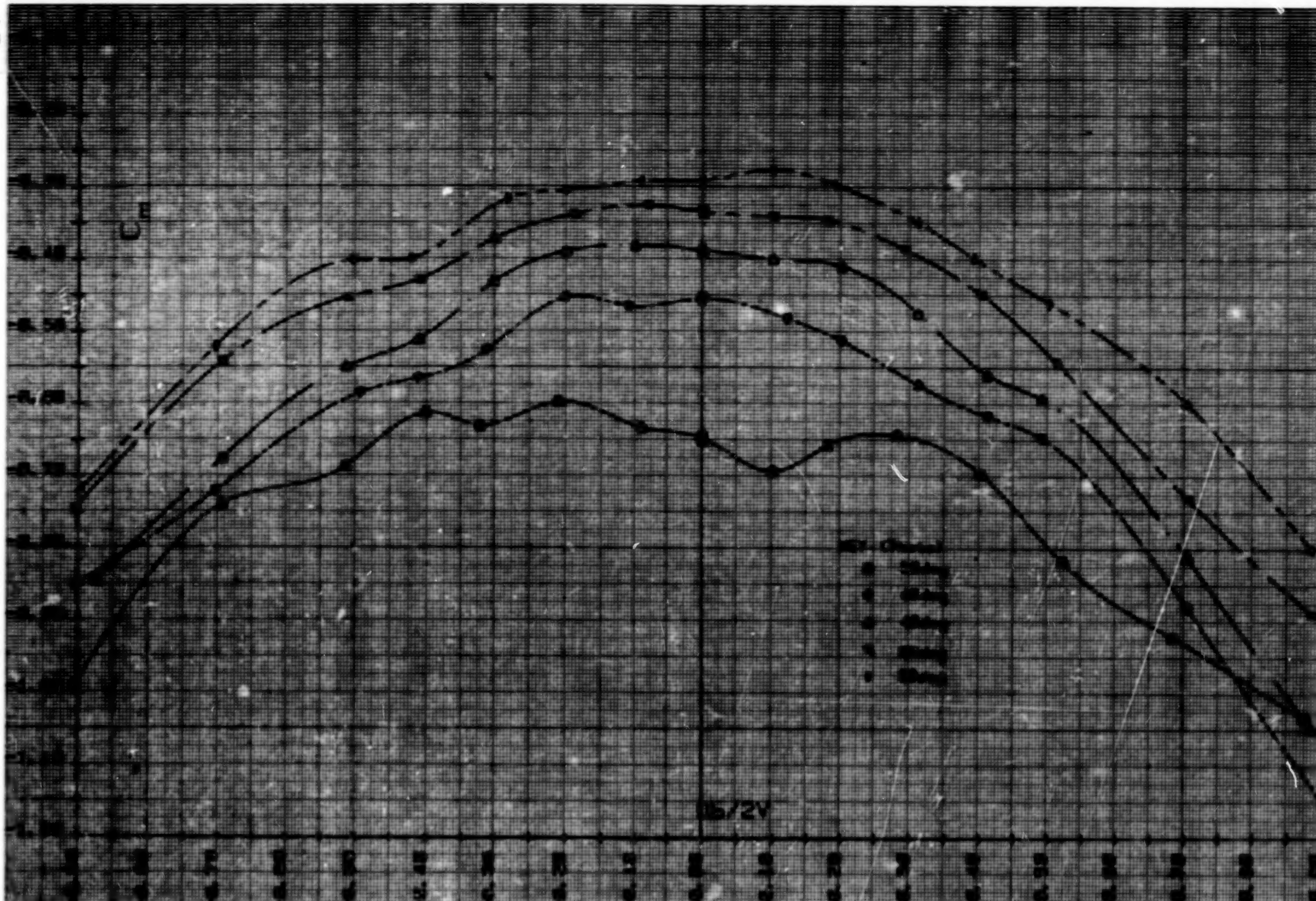
d.) Rolling-moment coefficient, Theta= 0 to 50deg; Phi= 10.7deg.

Figure 11.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



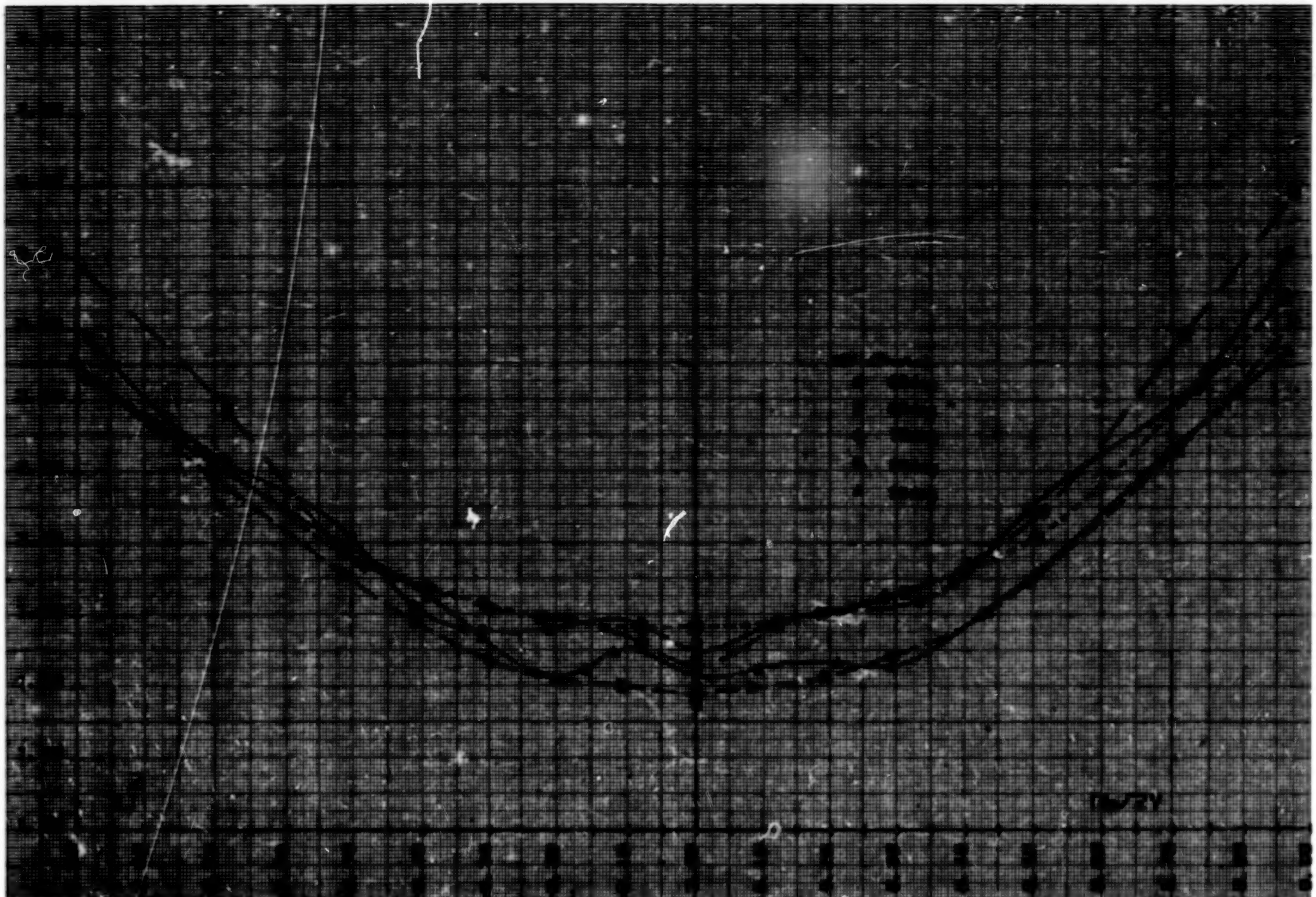
e.)Pitching-moment coefficient, Theta= 55 to 90deg; Phi= 10.6deg.

Figure 11.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



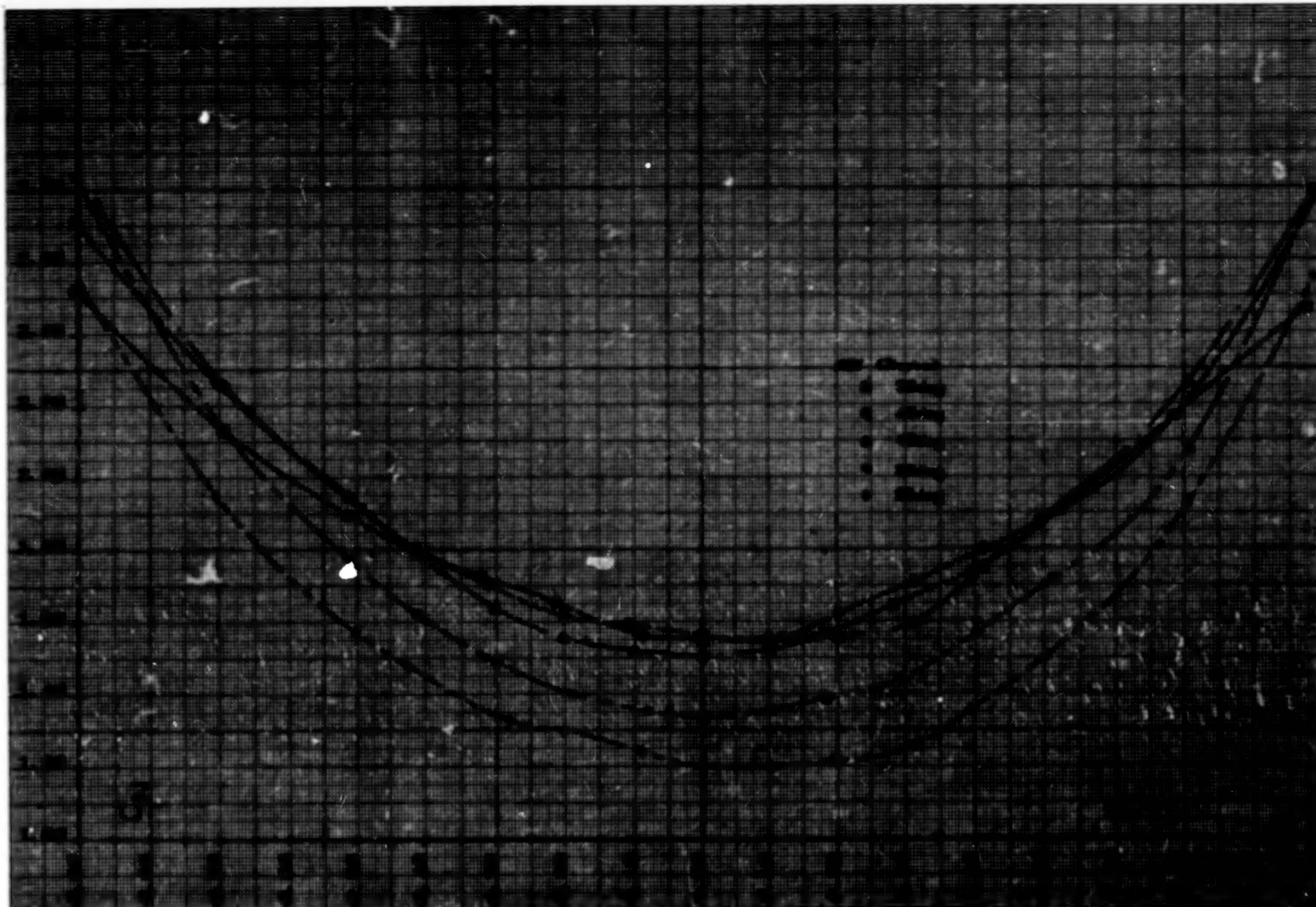
f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi= 10.7deg.

Figure 11.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



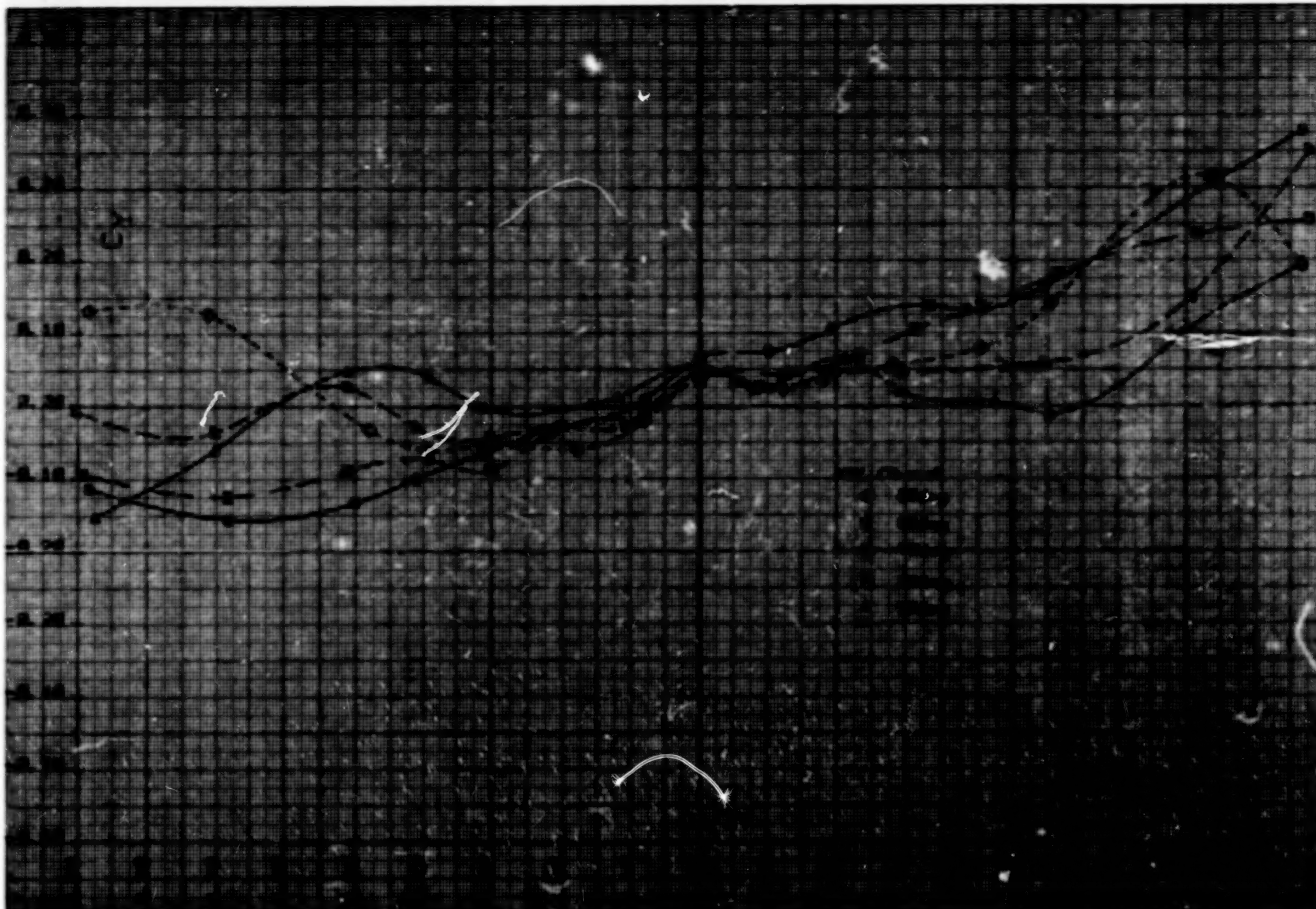
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi= 10.6deg.

Figure 11. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



h.) Normal-force coefficient, Theta= 30 to 50deg; Phi= 10.8deg.

Figure 11.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



i.) Side-force coefficient. Theta= 55 to 90deg; Phi= 10.7deg.

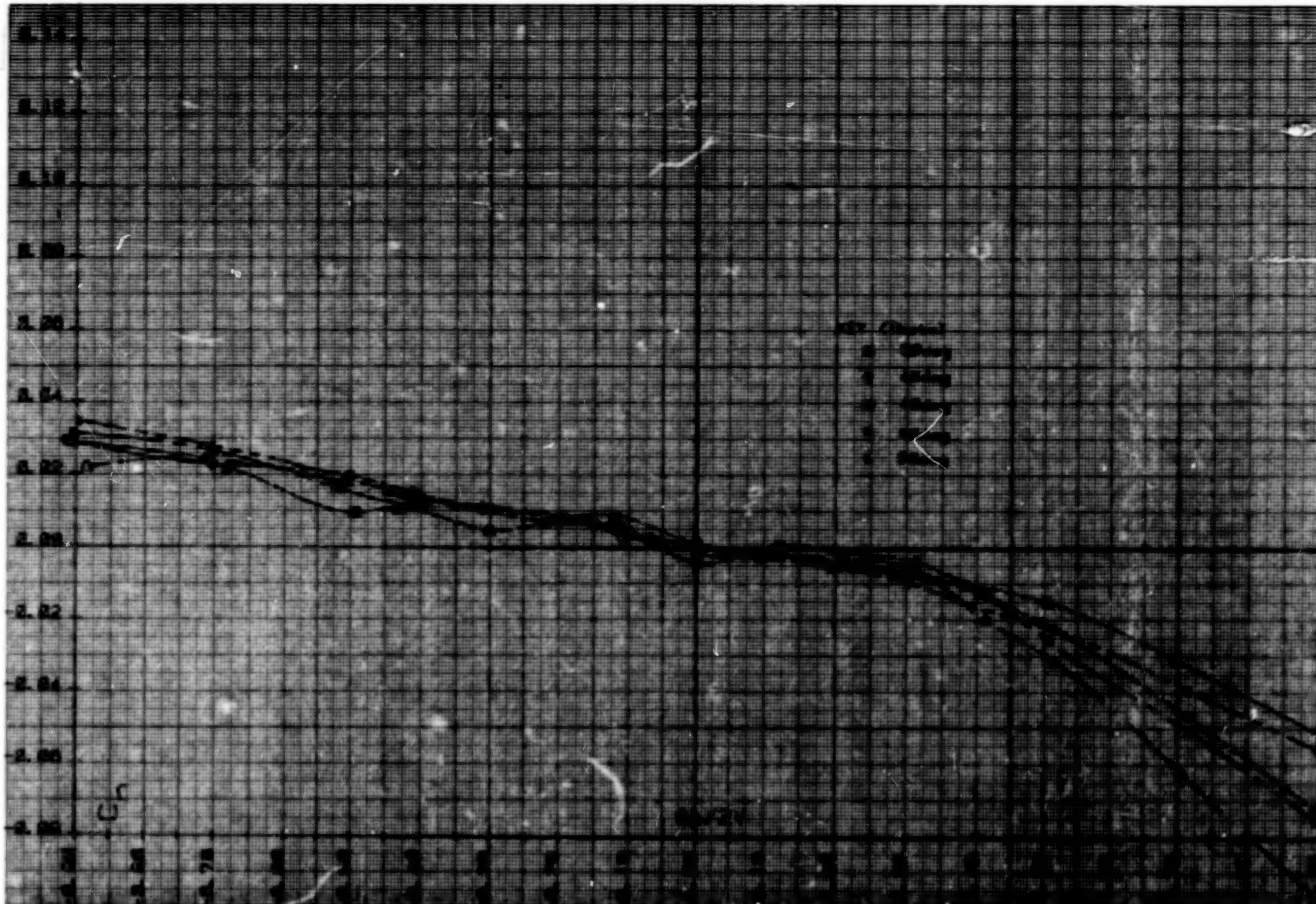
Figure 11.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.

j.) Side-force coefficient, Theta= 30 to 50deg; Phi= 10.7deg.

Figure 11.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.

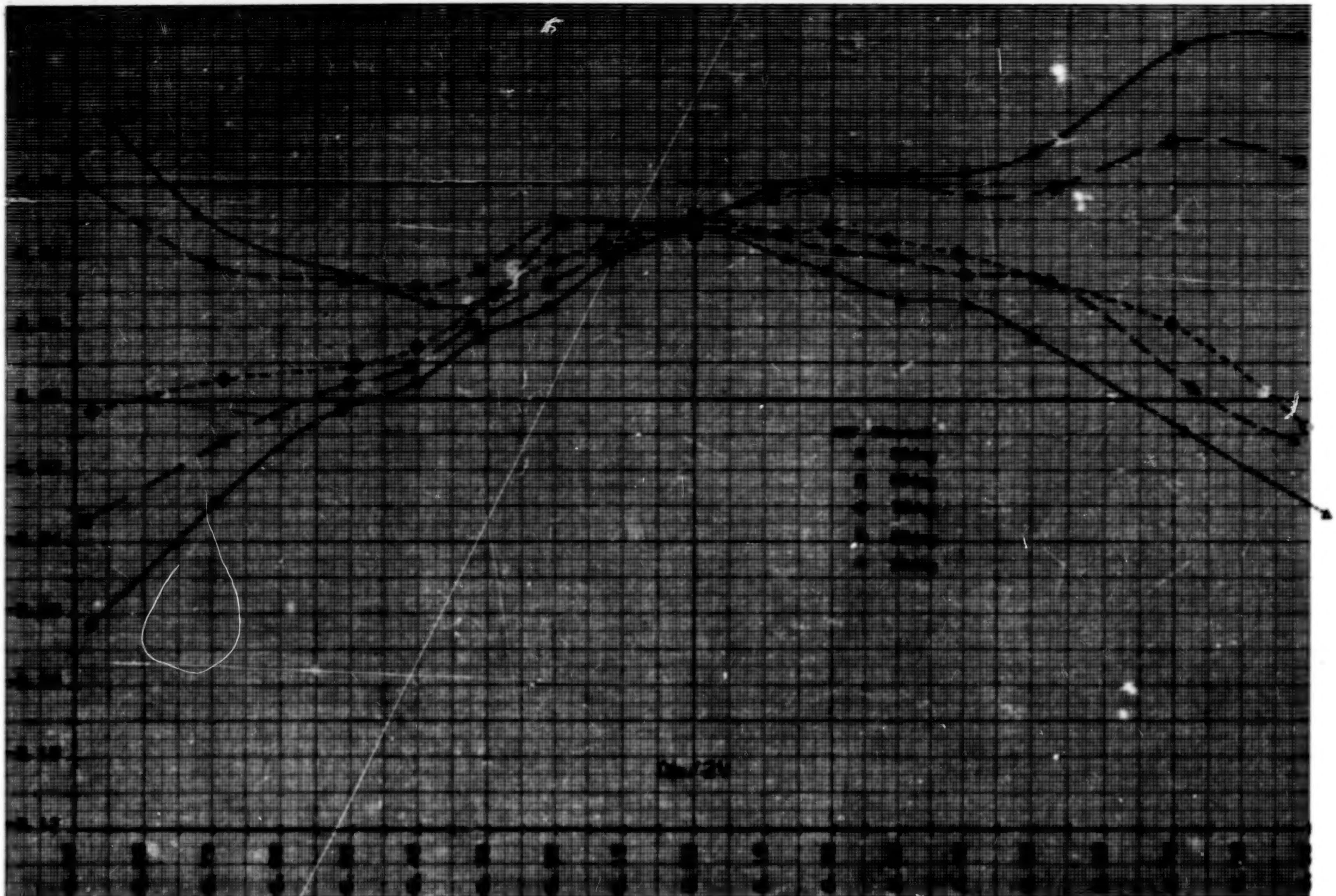
a.) Yawing-moment coefficient. Theta= 55 to 90deg; Phi=-10.0deg.

Figure 12.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-10.0deg.

Figure 12.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-10.0deg.

Figure 12.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.

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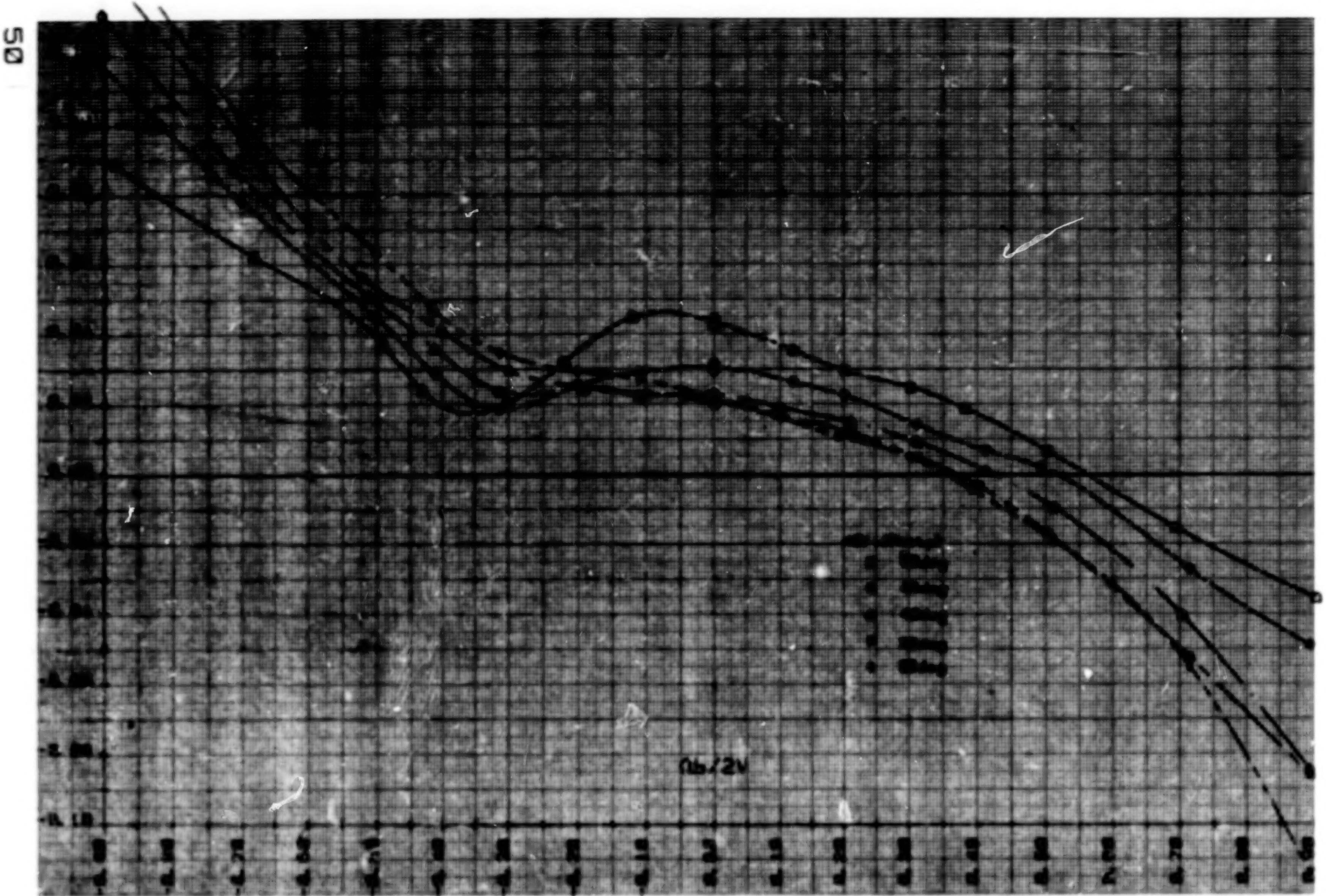
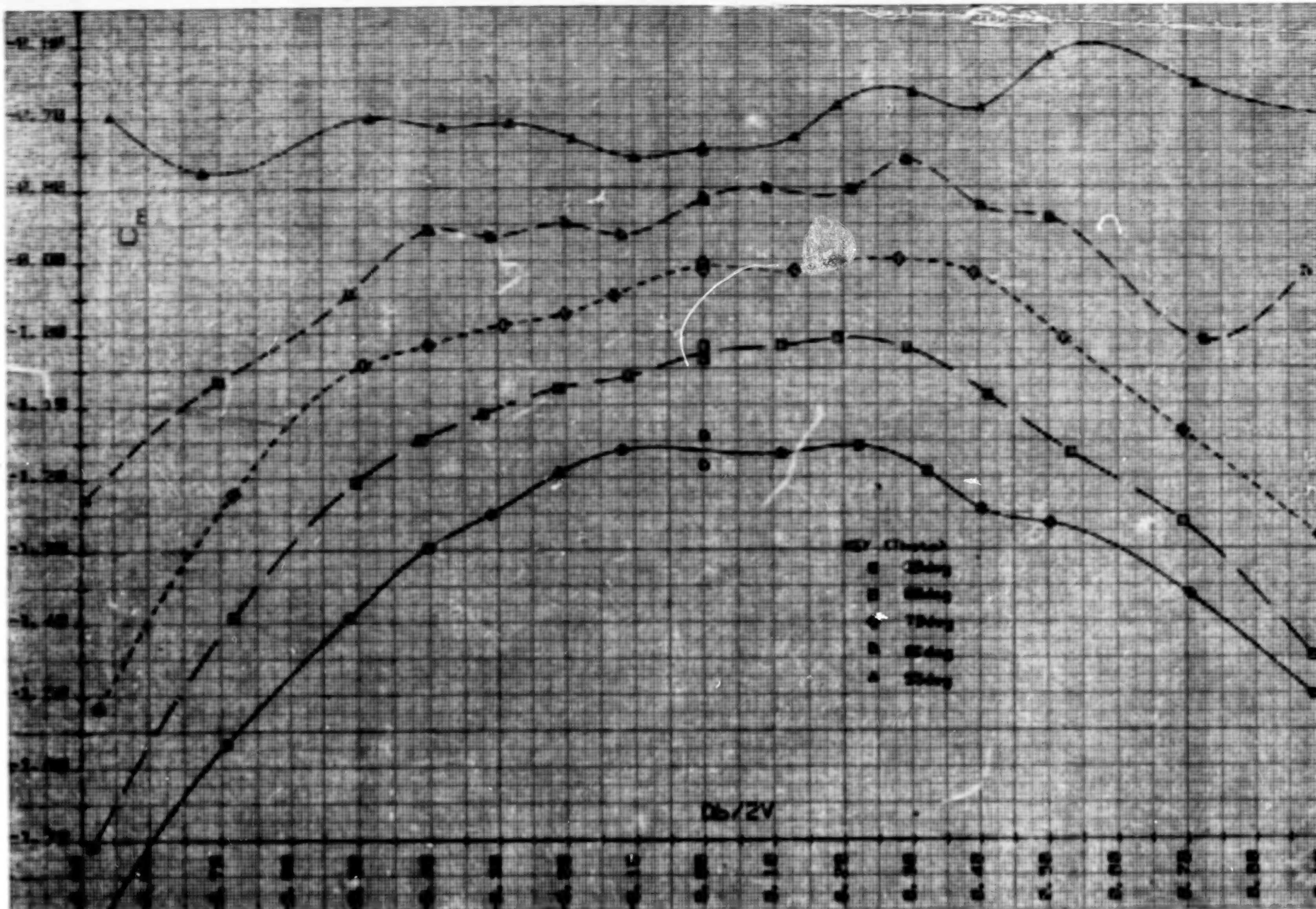


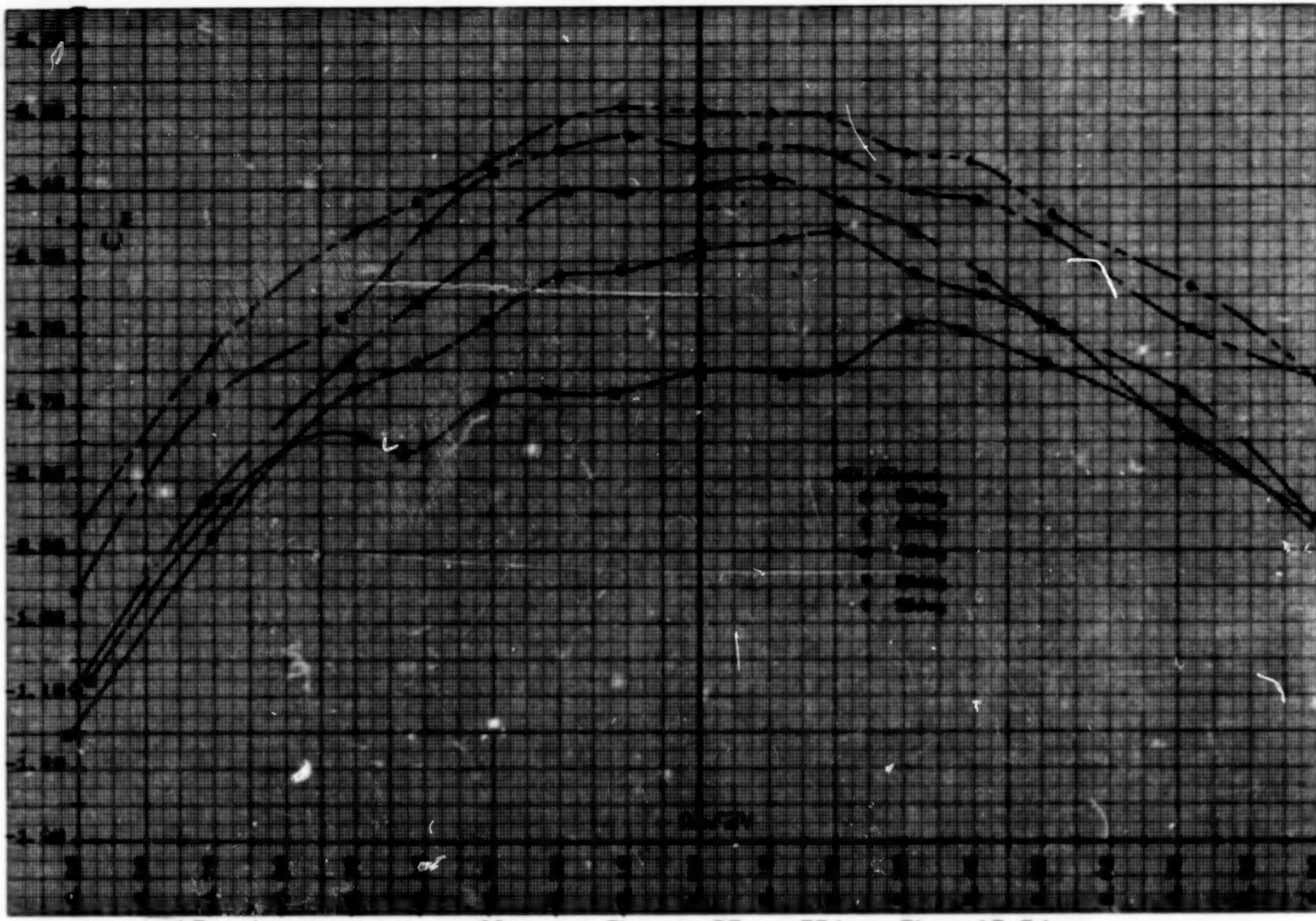
d.)Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-10.0deg.

Figure 12. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



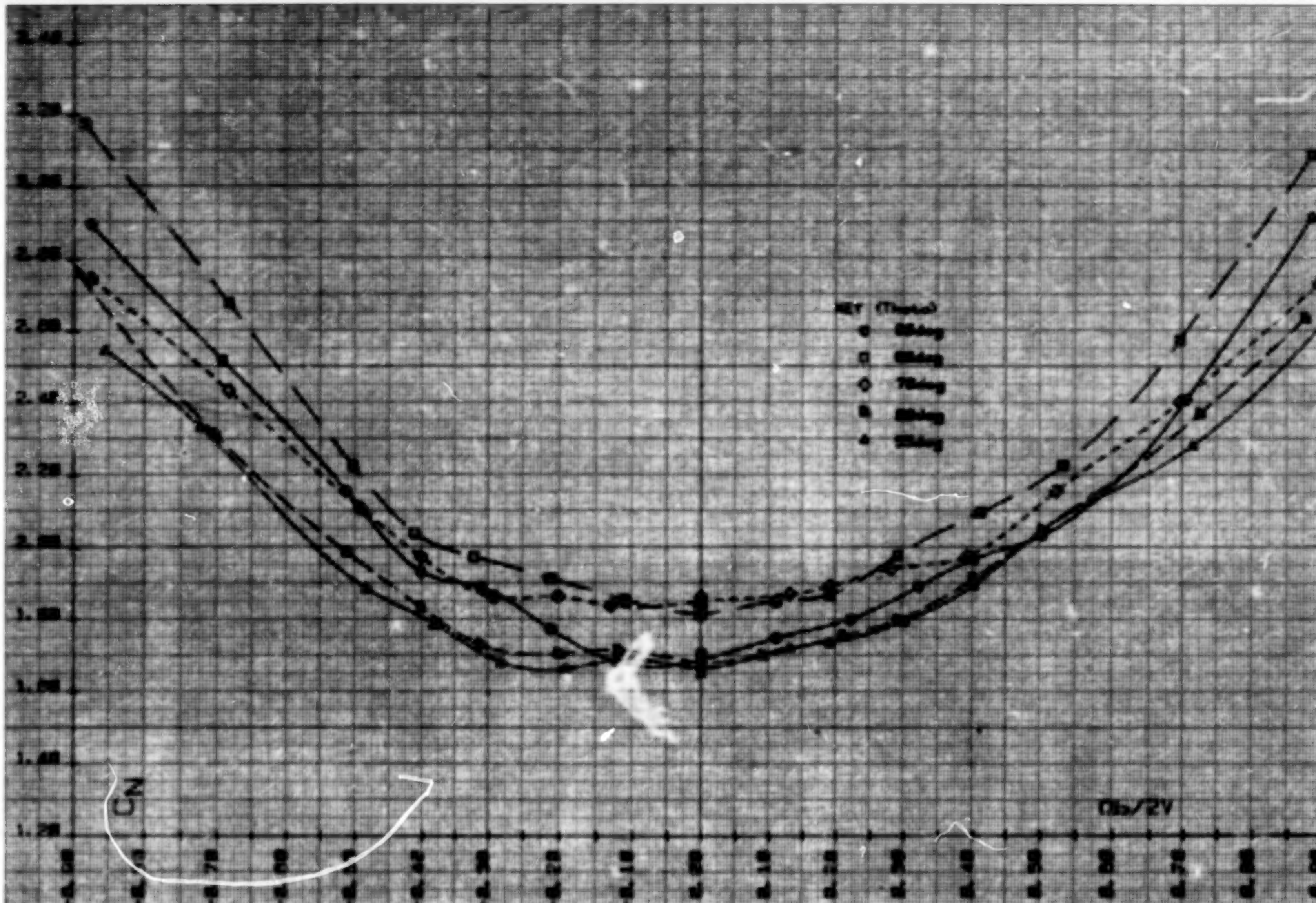
a.)Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-10.0deg.

Figure 12.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



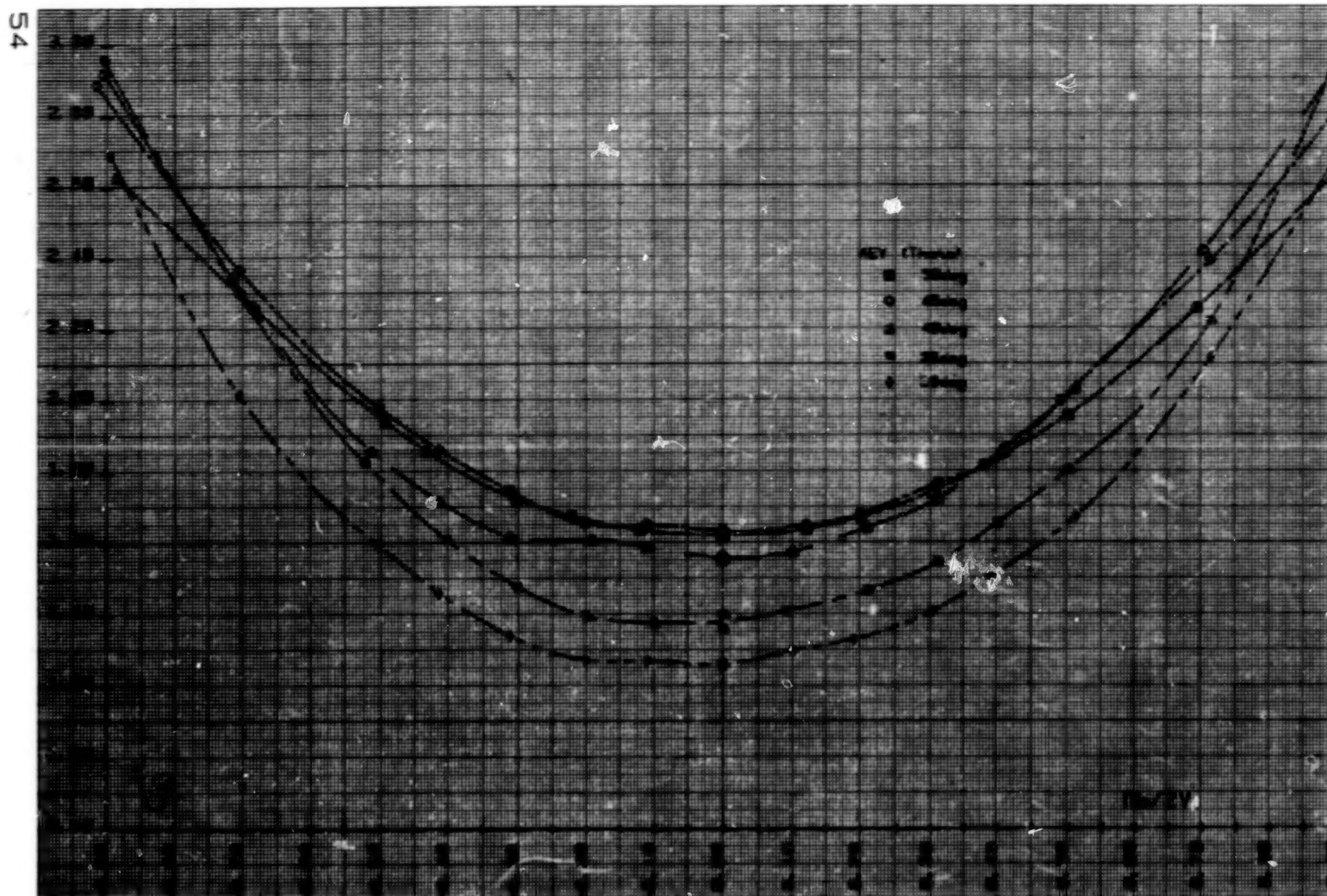
f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-10.0deg.

Figure 12.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



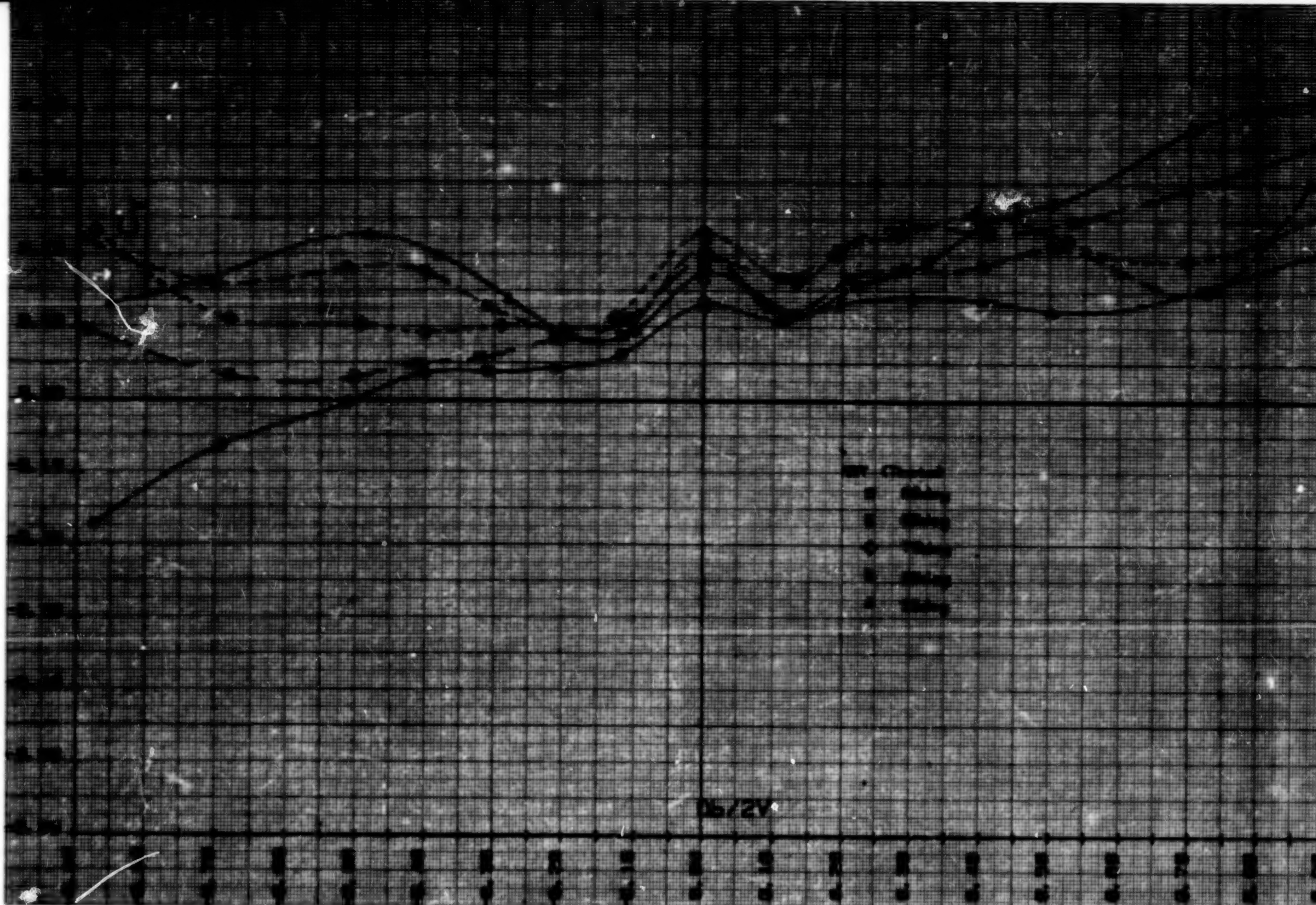
g.)Normal-force coefficient, Theta= 55 to 90deg; Phi=-10.0deg.

Figure 12.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-10.1deg.

Figure 12.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



1.) Side-force coefficient, Theta= 55 to 90deg; Phi=-10.0deg.

Figure 12.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.

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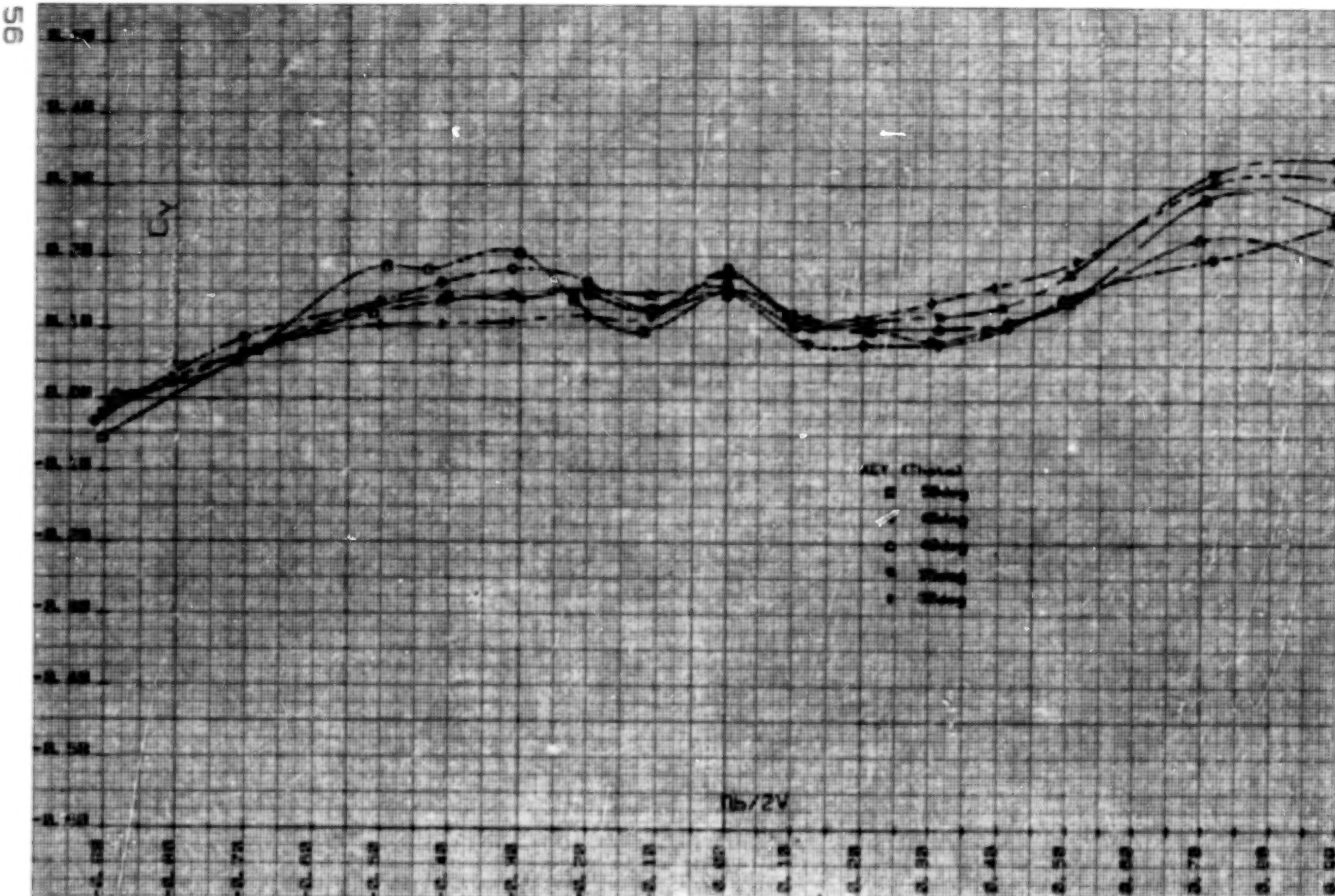
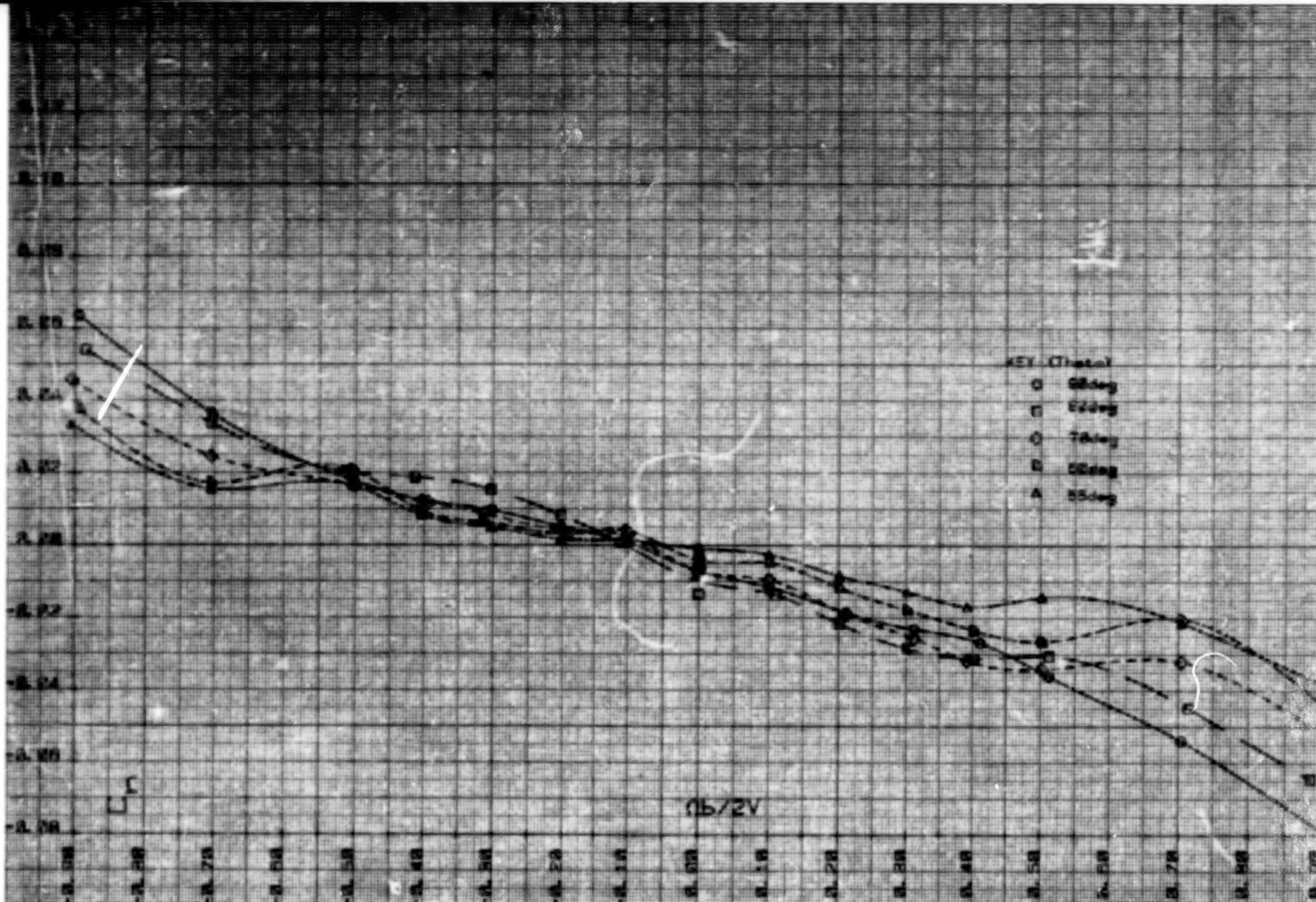


j.) Side-force coefficient. Theta= 30 to 50deg; Phi=-10.0deg.

Figure 12.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-5.2deg.

Figure 13.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.

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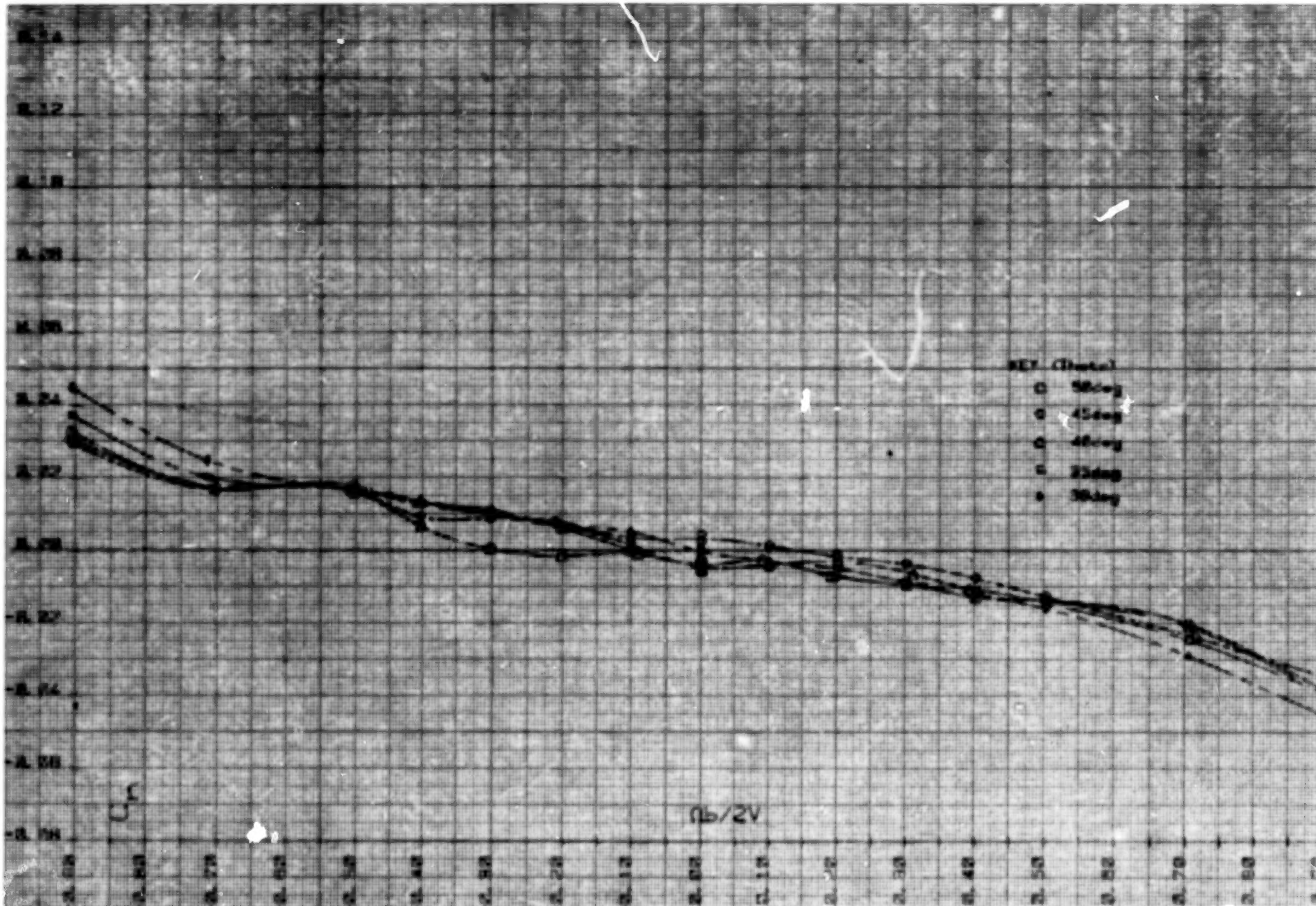
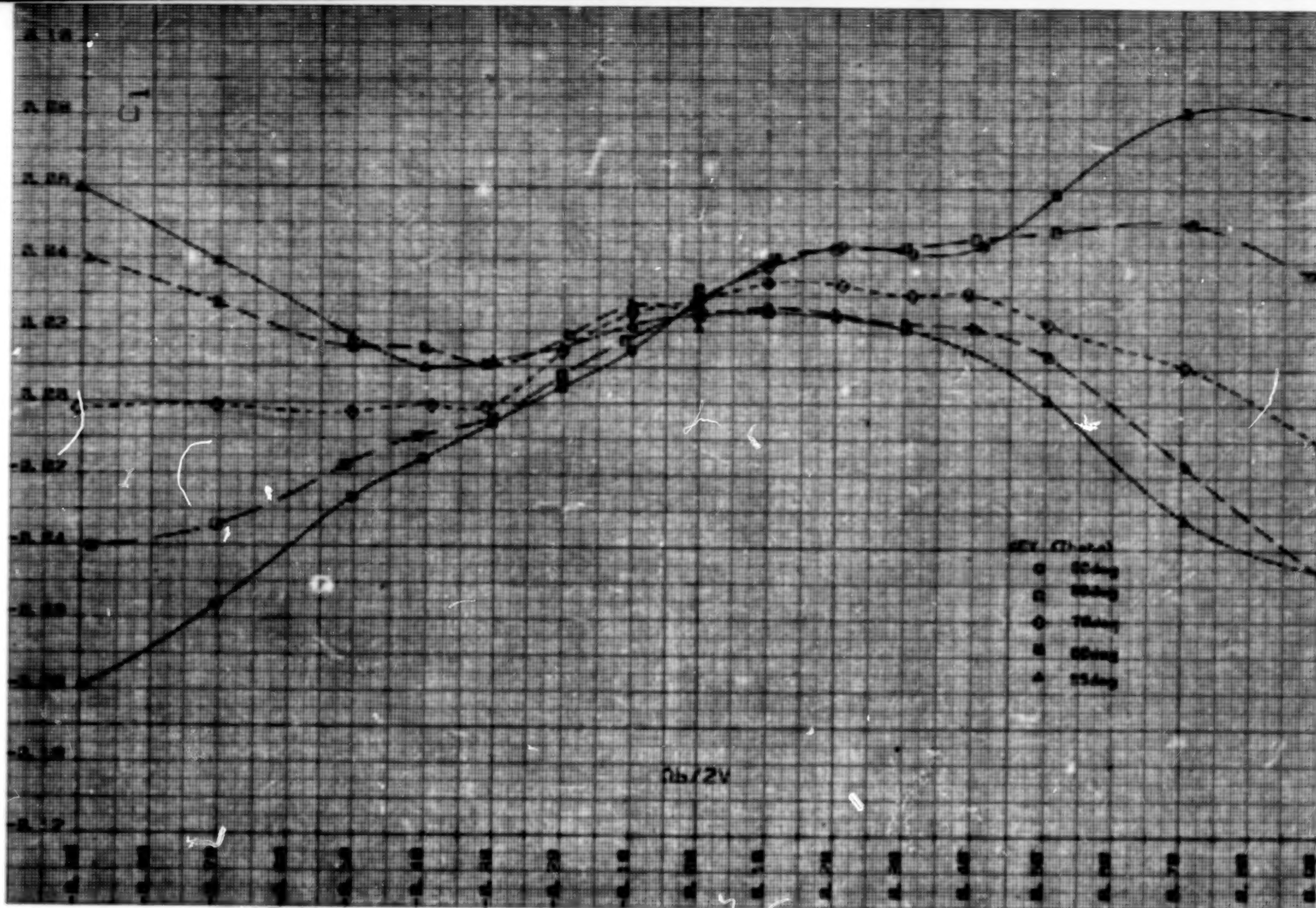


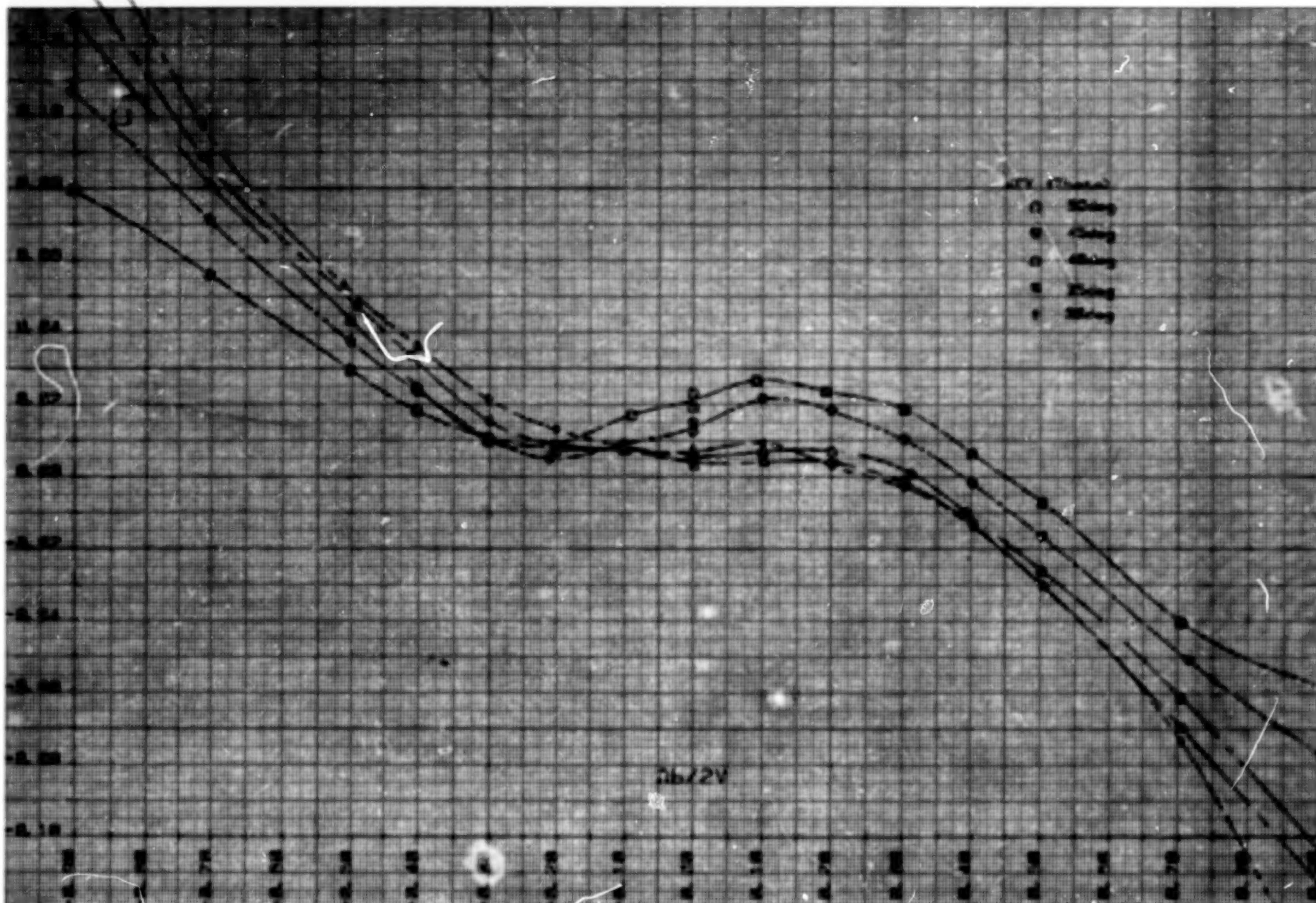
b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-5.2deg.

Figure 13.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



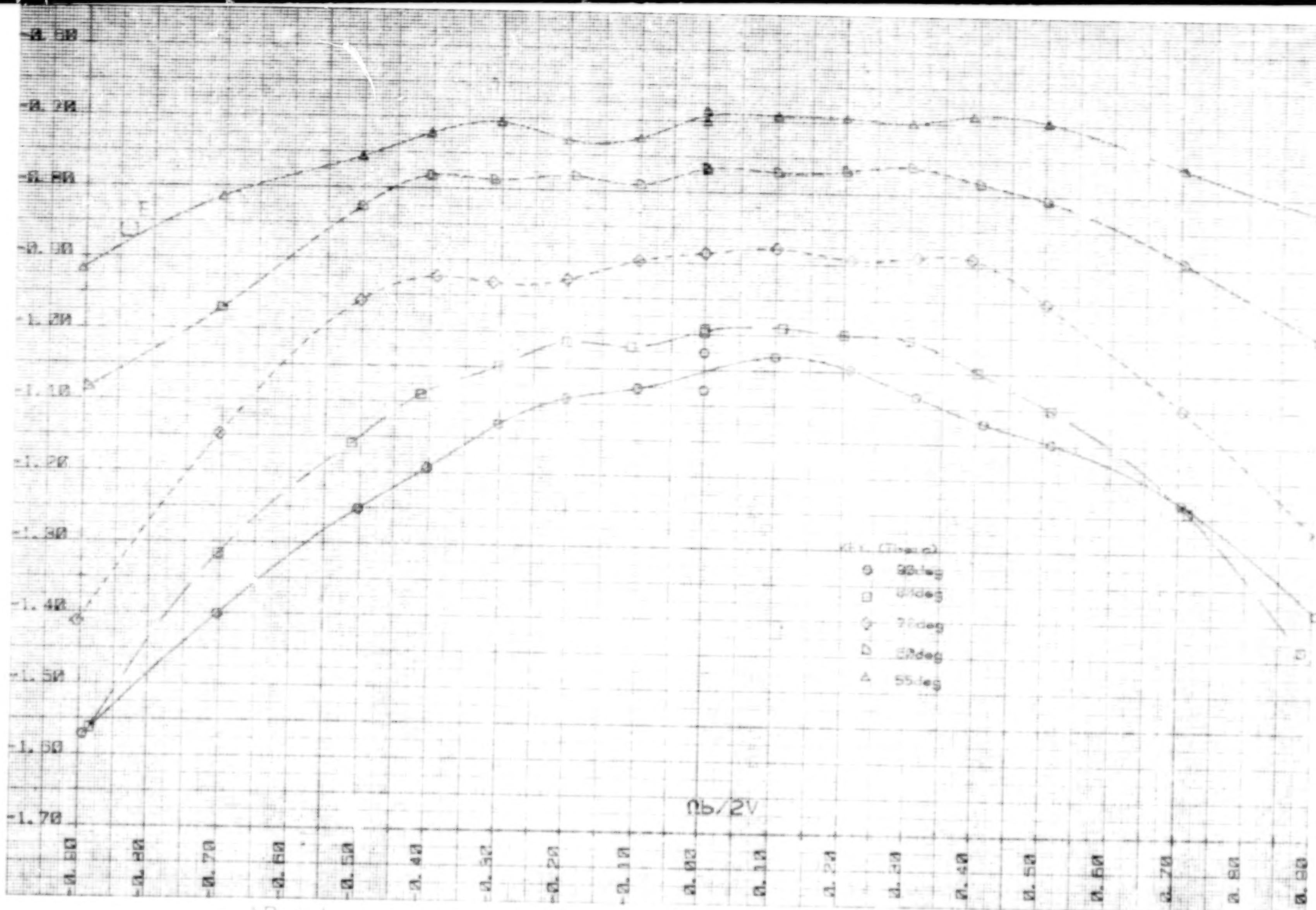
c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-5.1deg.

Figure 13.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



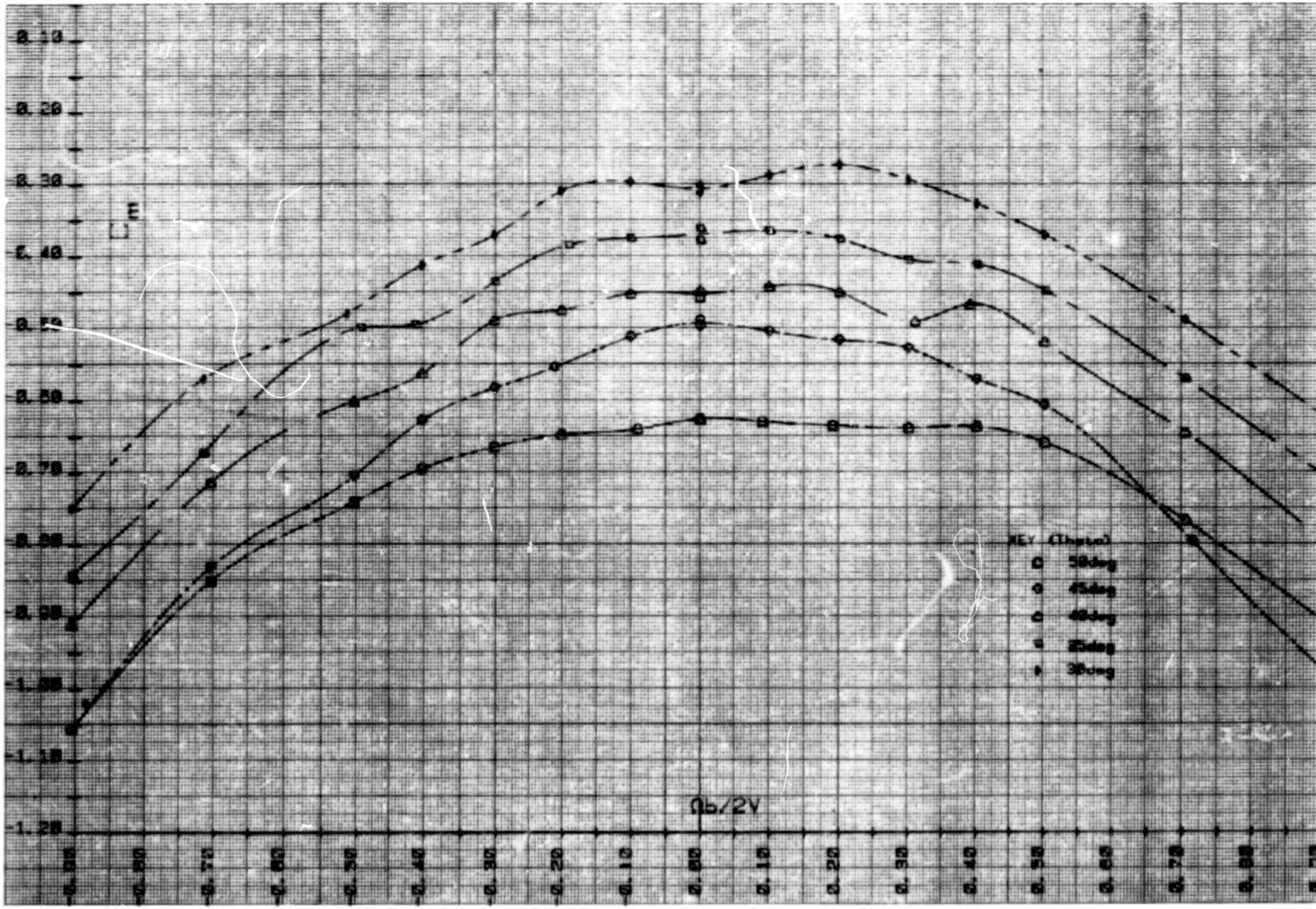
d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-5.2deg.

Figure 13.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



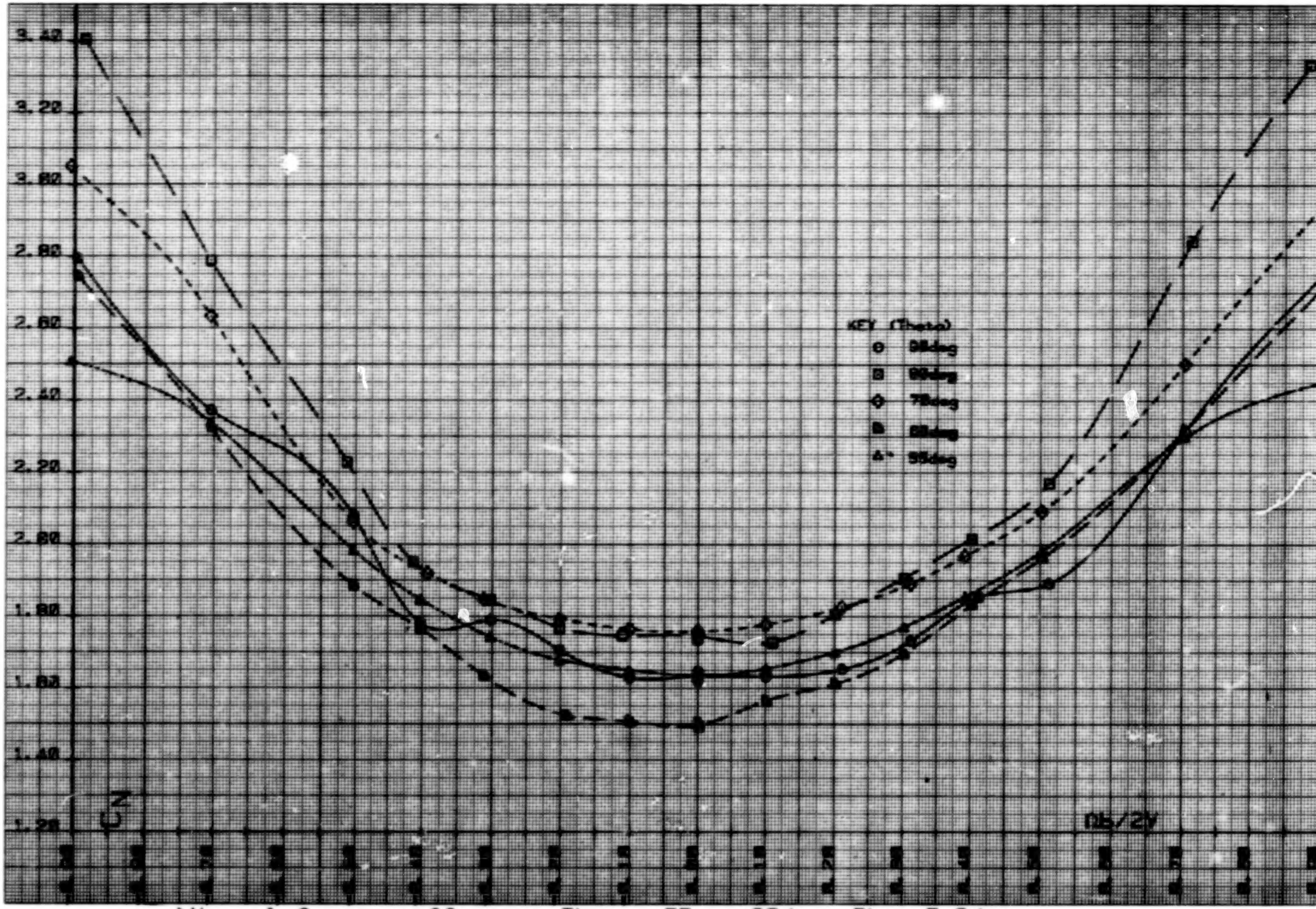
(c.)Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-5.2deg.

Figure 13.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



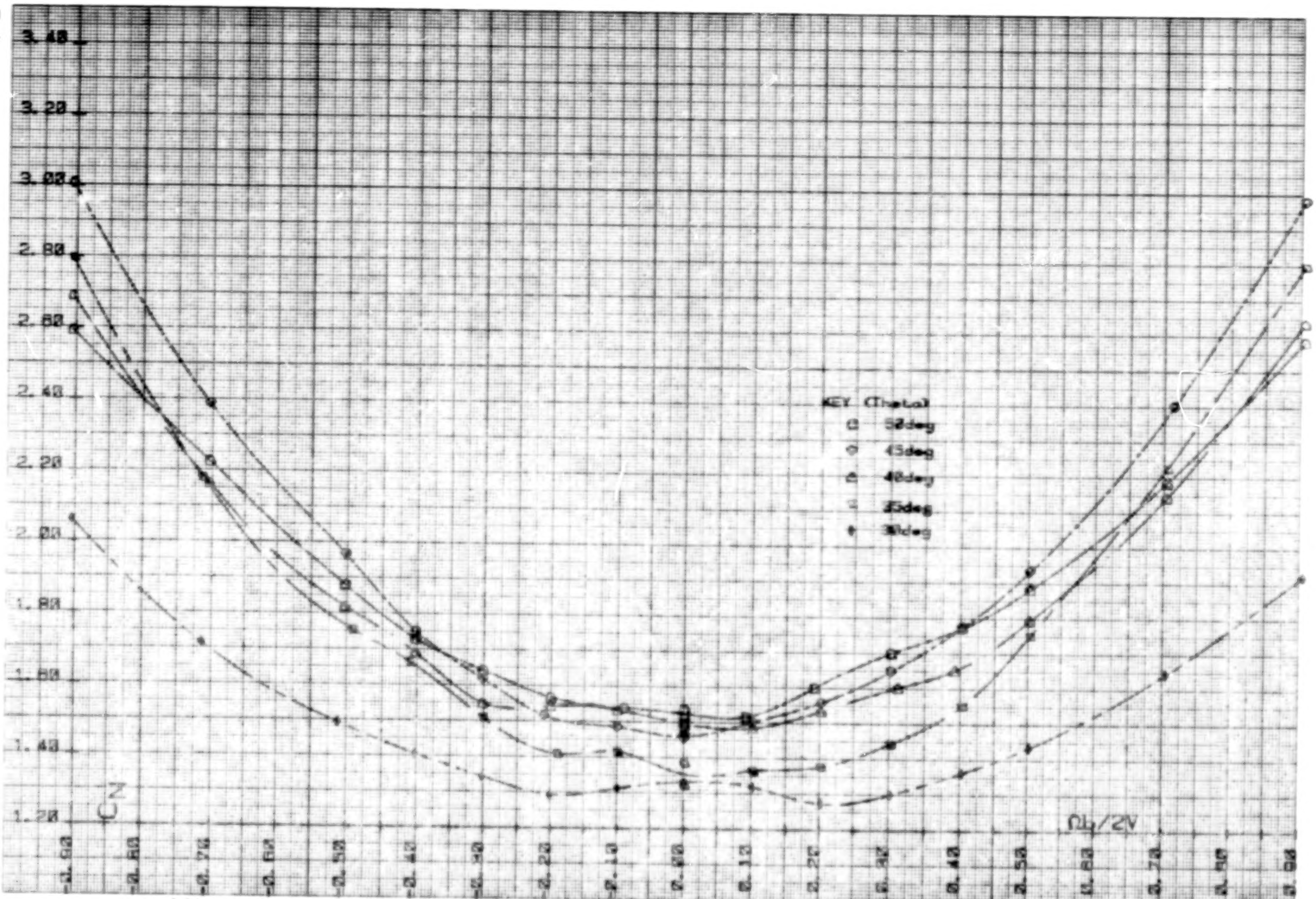
f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-5.1deg.

Figure 13.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



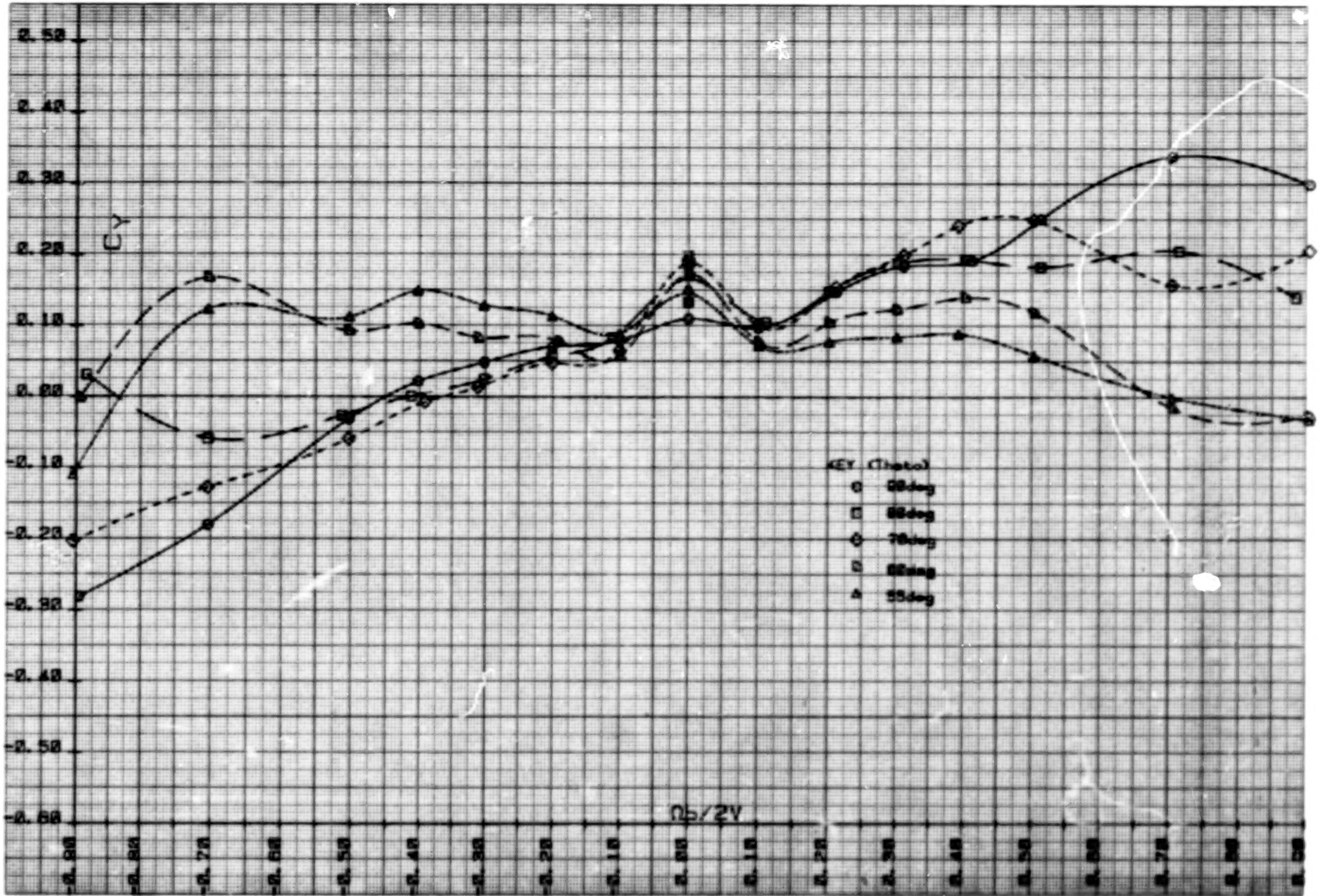
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-5.2deg.

Figure 13.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



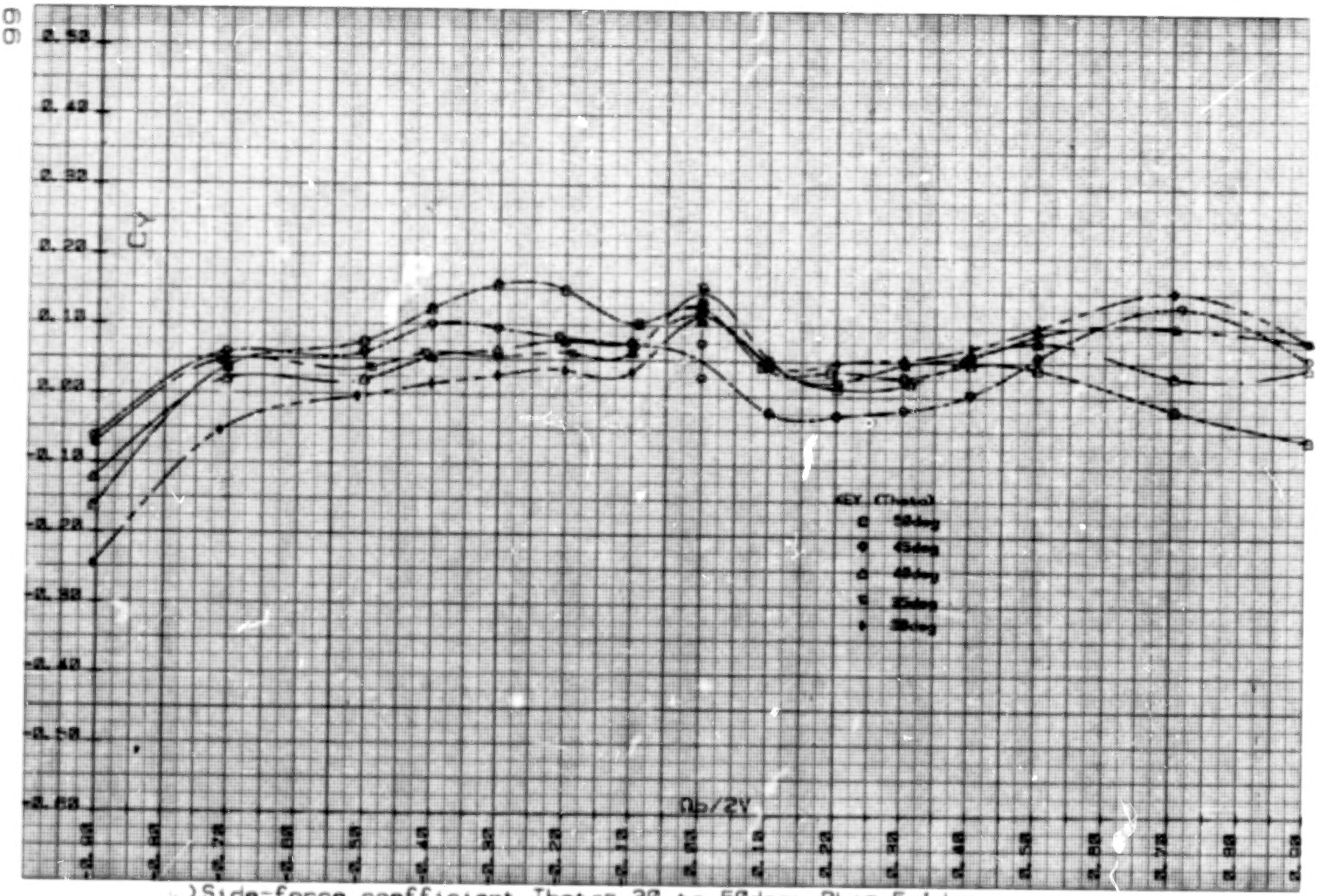
(.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-5.2deg.

Figure 13.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



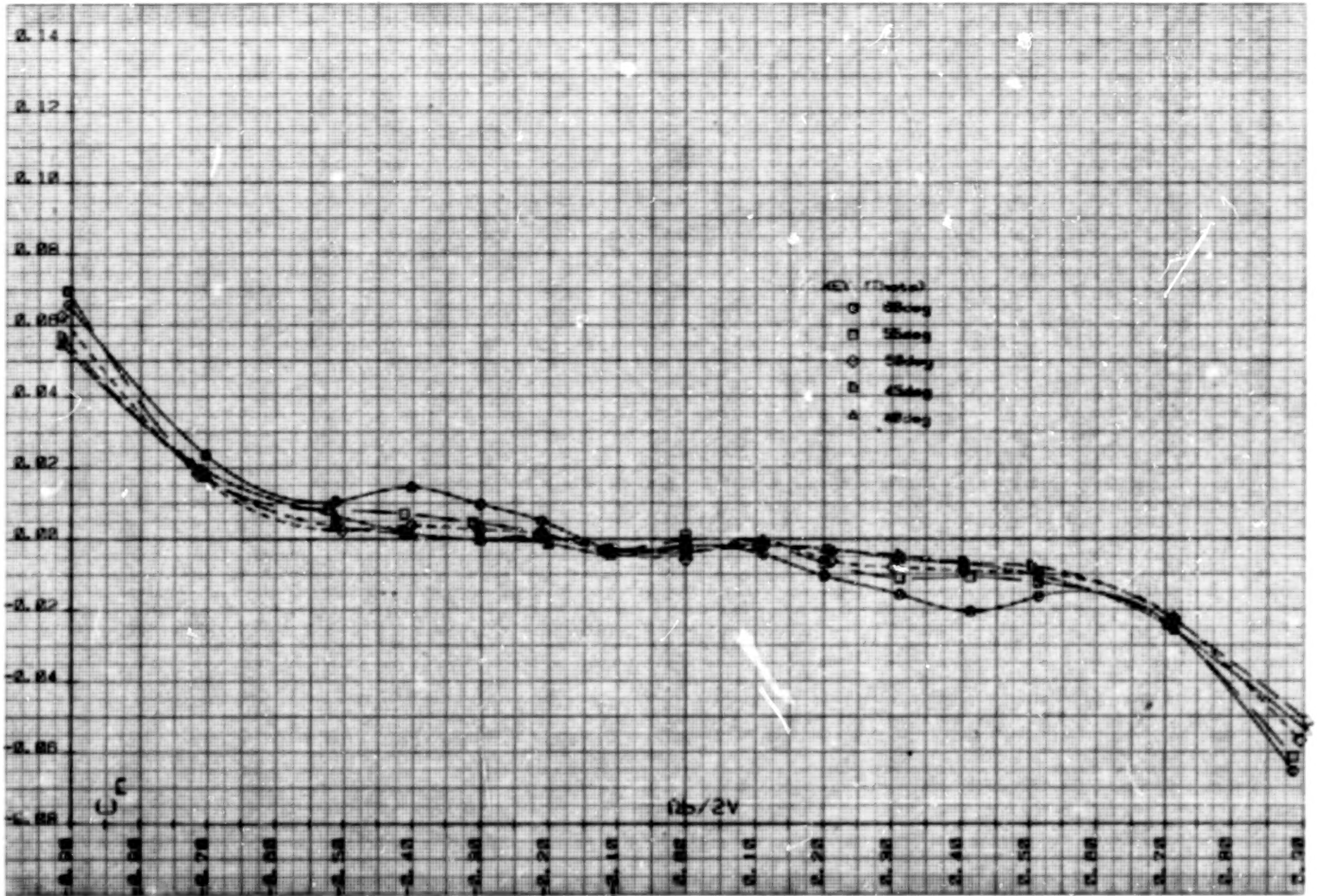
(.) Side-force coefficient. Theta= 55 to 90deg; Phi=-5.1deg.

Figure 13.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



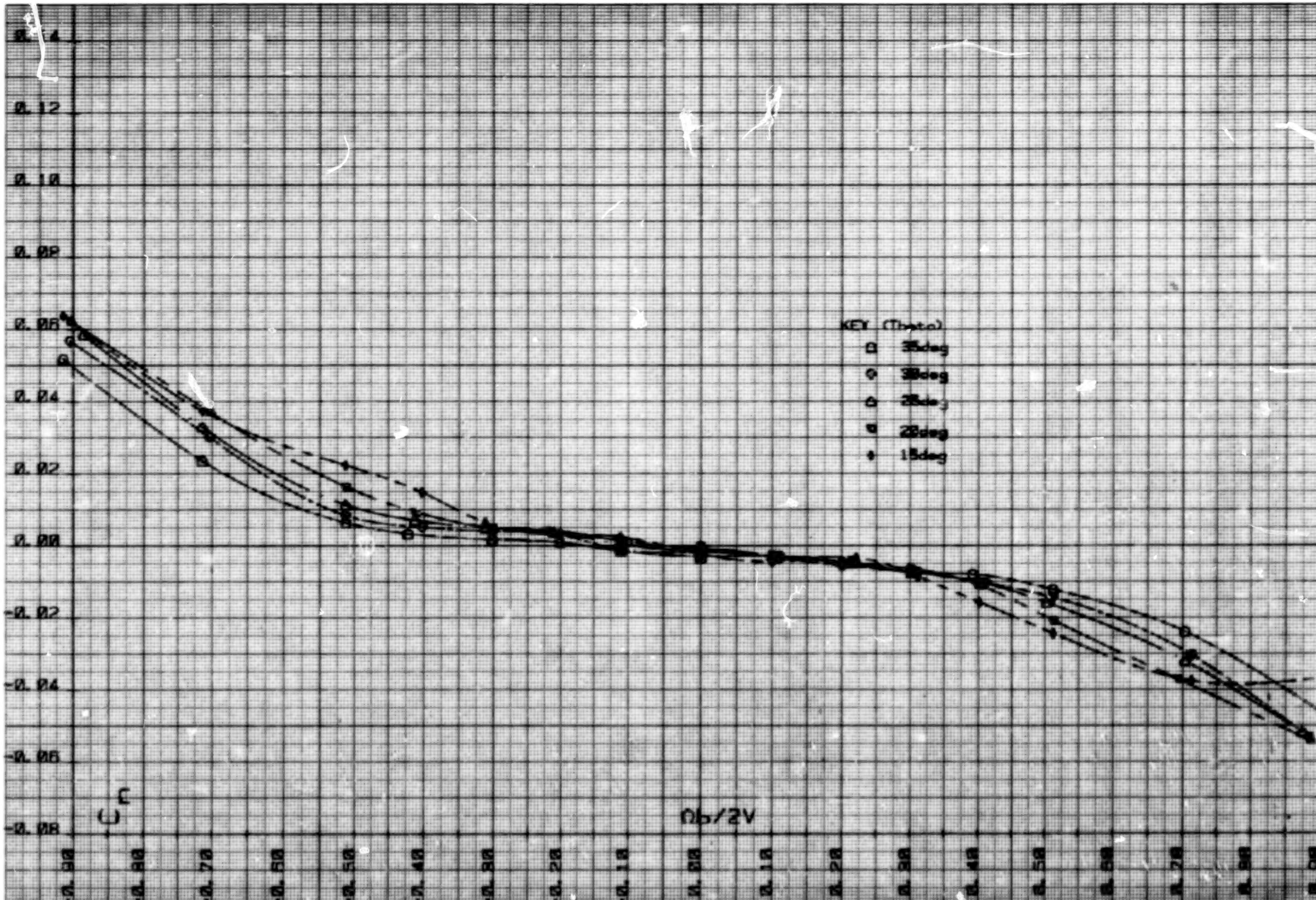
(j.) Side-force coefficient. Theta= 30 to 50deg; Phi=-5.1deg.

Figure 13.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V.



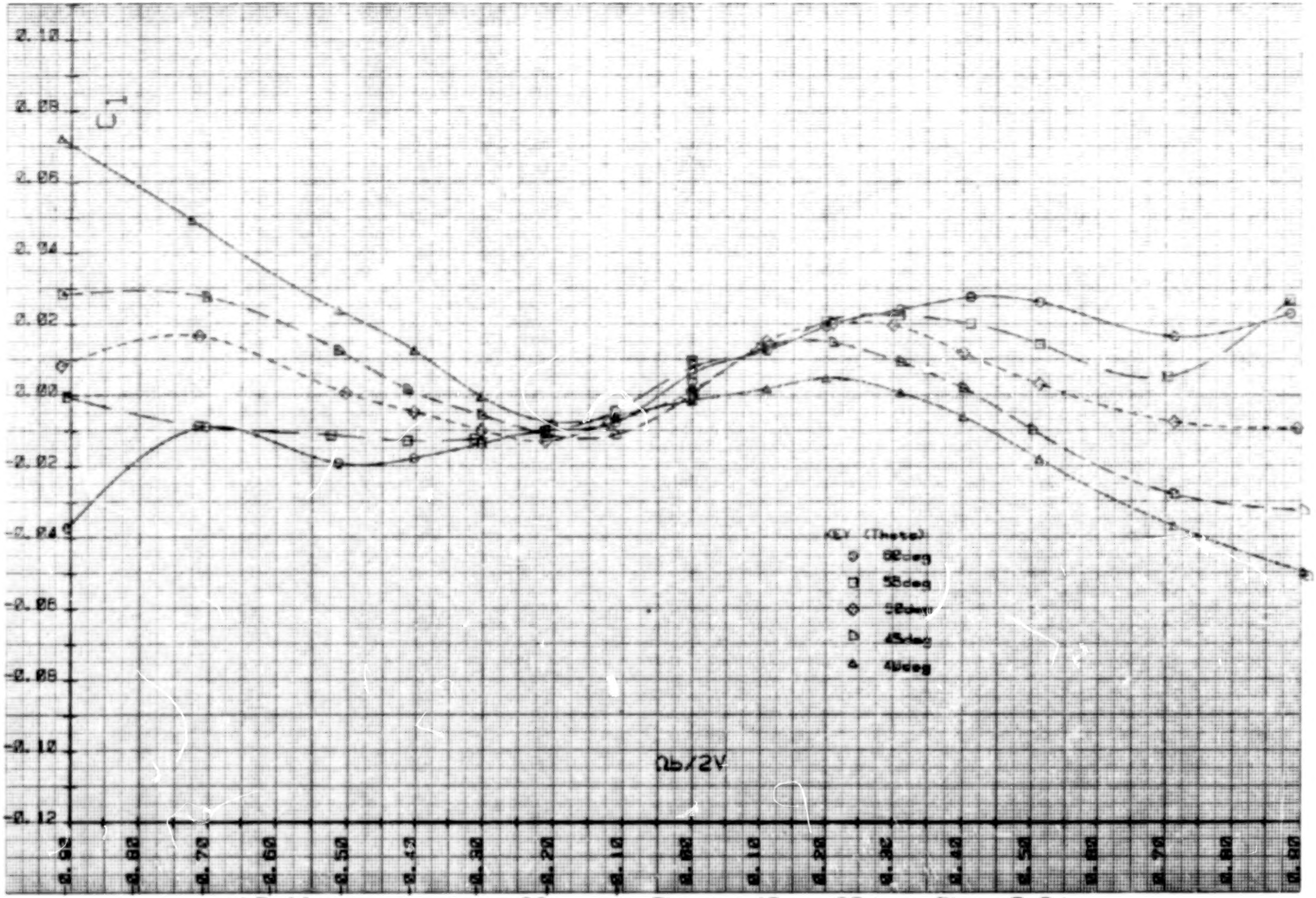
a.) Yawing-moment coefficient, Theta= 40 to 60deg; Phi=-0.3deg.

Figure 14.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V 6"SR.



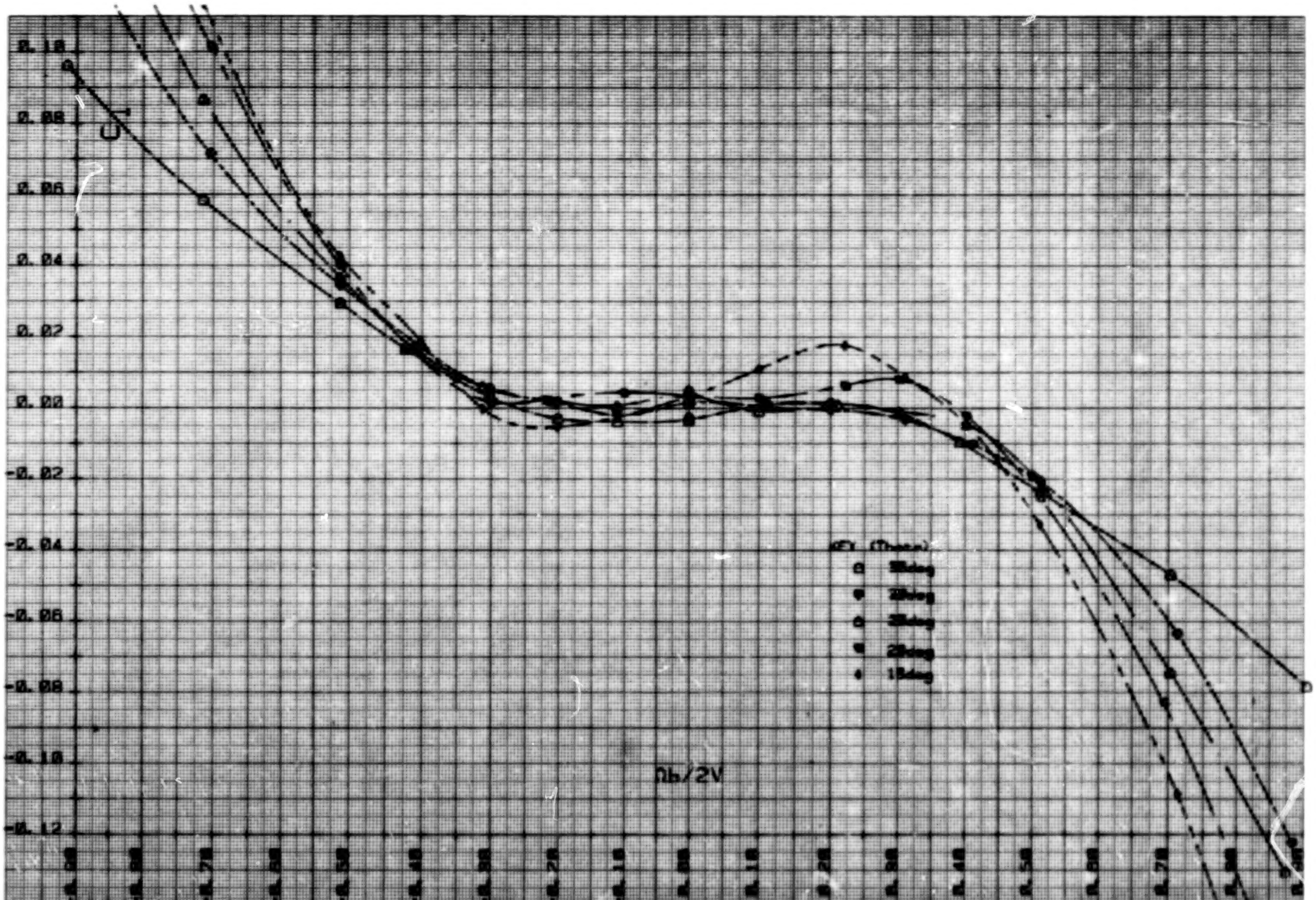
b.) Yawing-moment coefficient, Theta= 15 to 35deg; Phi=-Ø.3deg.

Figure 14.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V 6"SR.



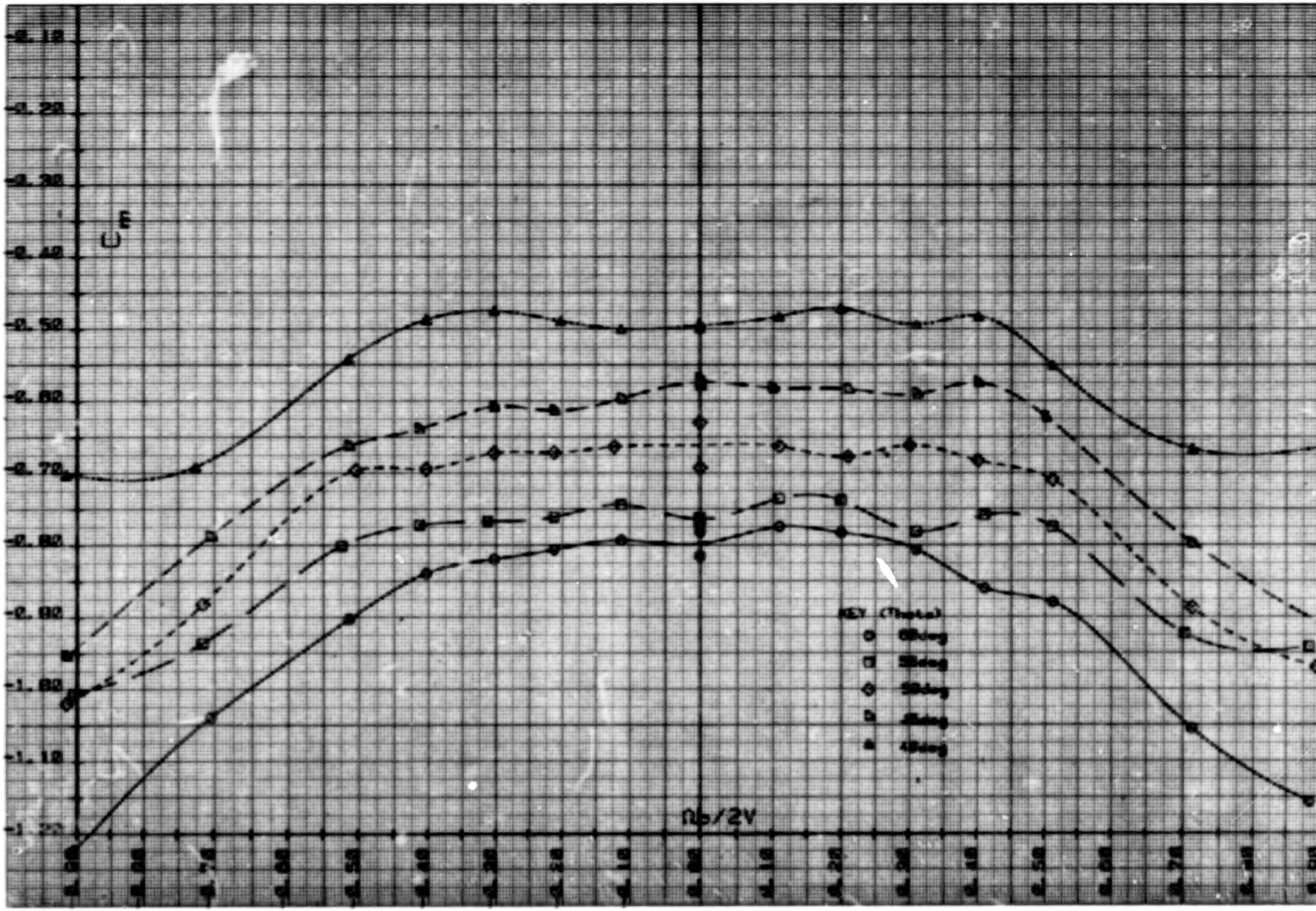
c.) Rolling-moment coefficient, Theta= 40 to 60deg; Phi=-0.3deg.

Figure 14.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V 6"SR.



d.) Rolling-moment coefficient, Theta= 15 to 35deg; Phi=-0.3deg.

Figure 14. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V 6"SR.



a.)Pitching-moment coefficient. Theta= 40 to 60deg; Phi=-0.3deg.

Figure 14.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V 6"SR.

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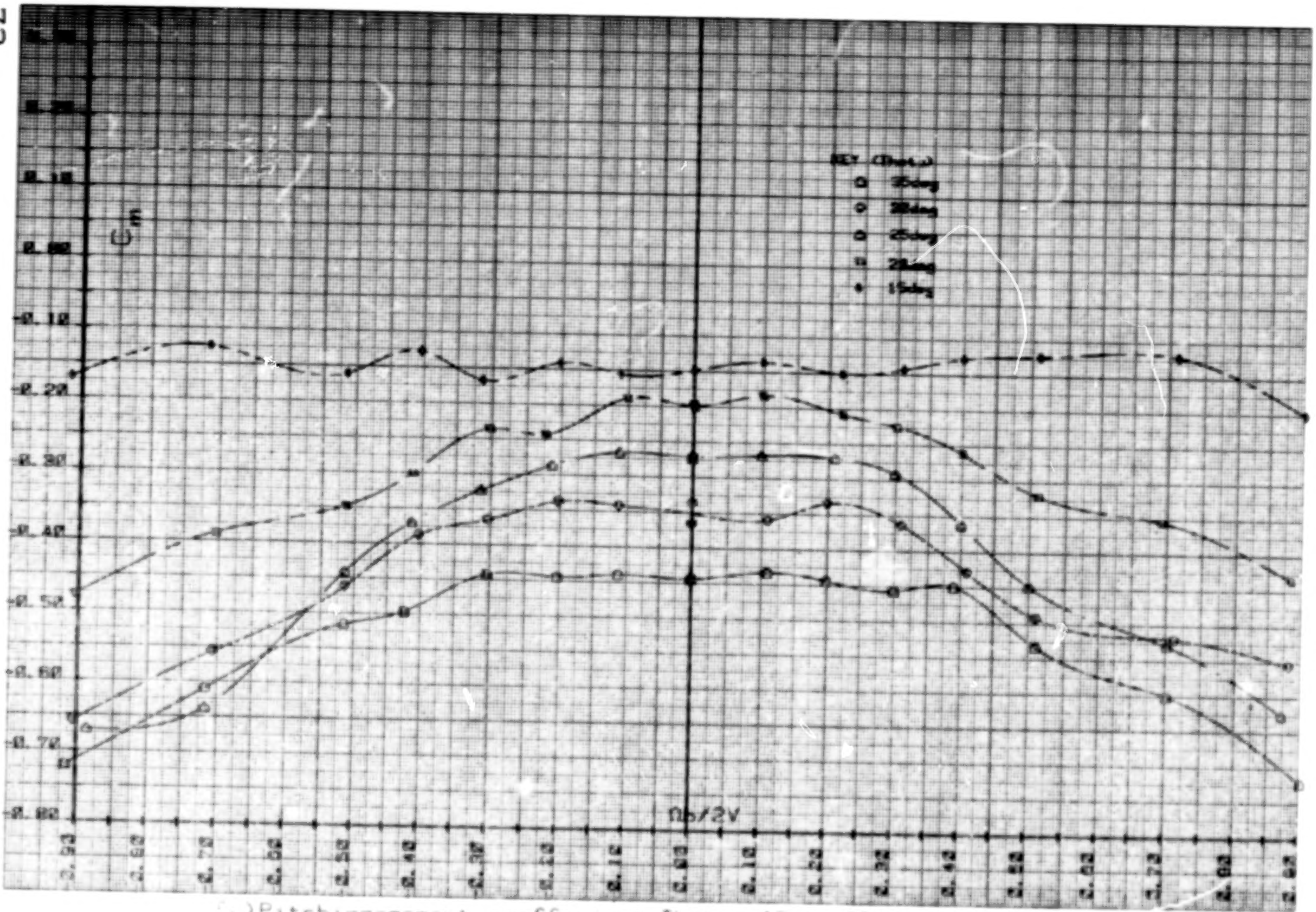
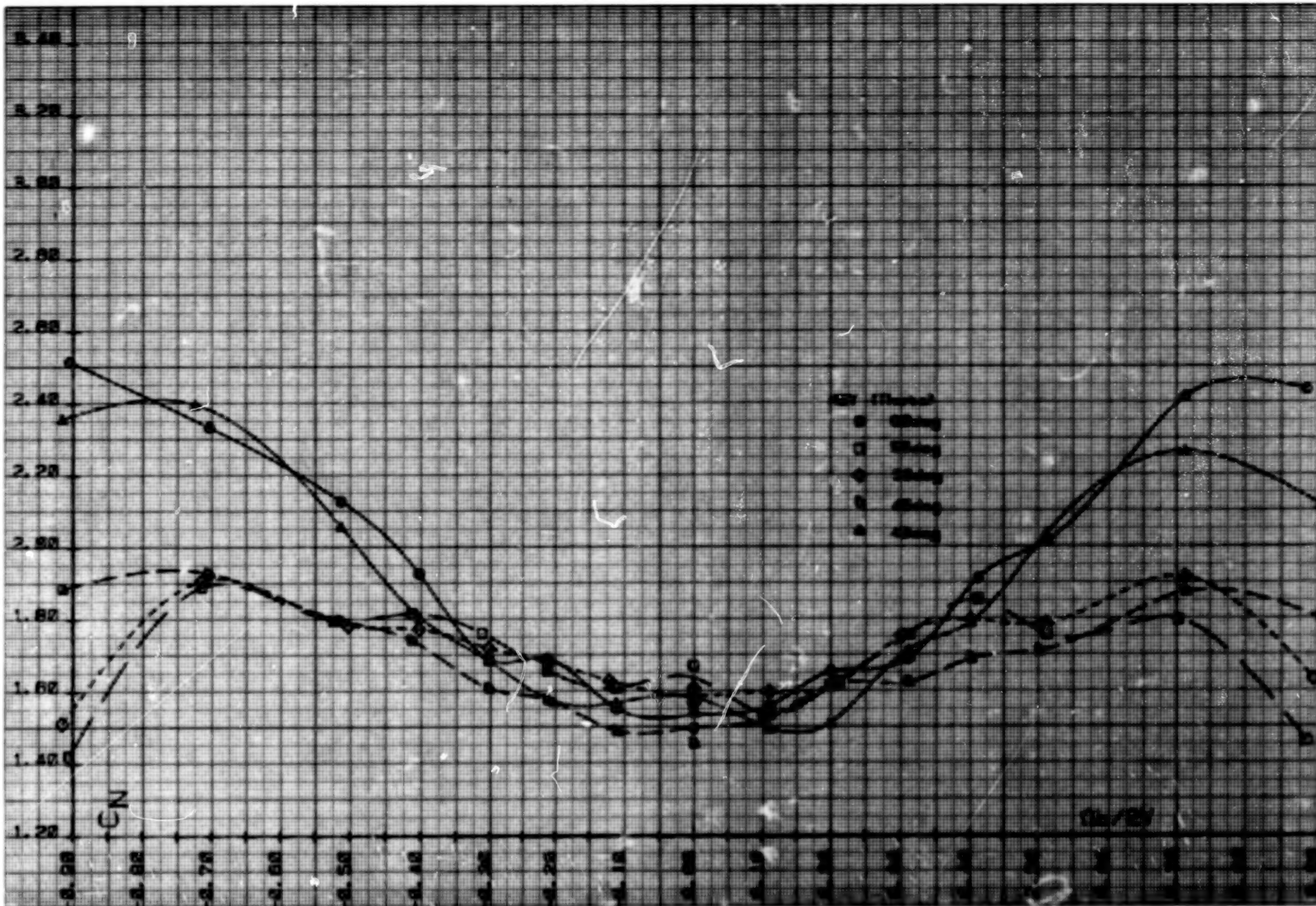


.)Pitching-moment coefficient, Theta= 15 to 35deg; Phi=-0.3deg.

Figure 14.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V 6"SR.



g.) Normal-force coefficient, Theta= 40 to 60deg; Phi=-0.3deg.

Figure 14.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V 6"SR.

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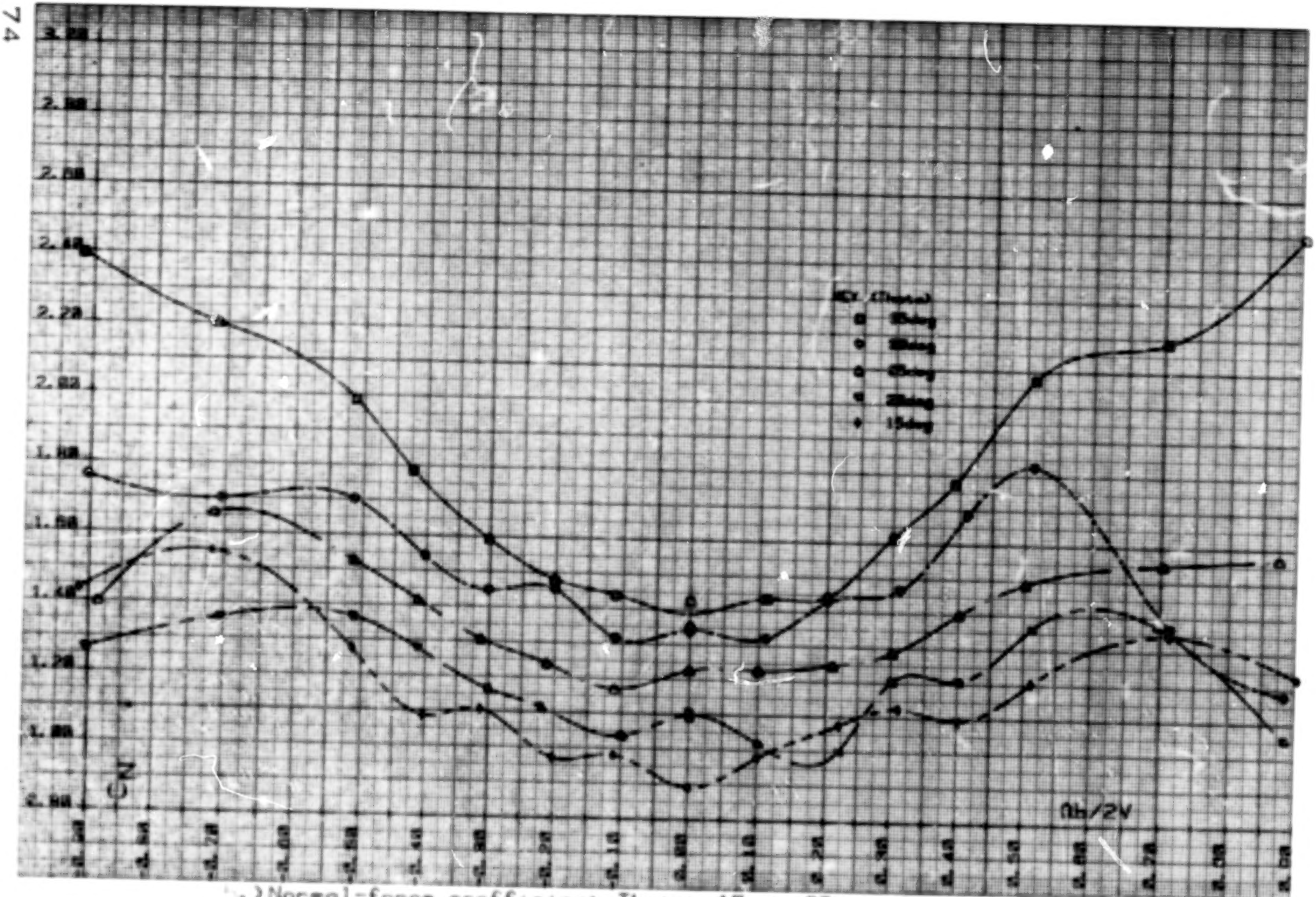
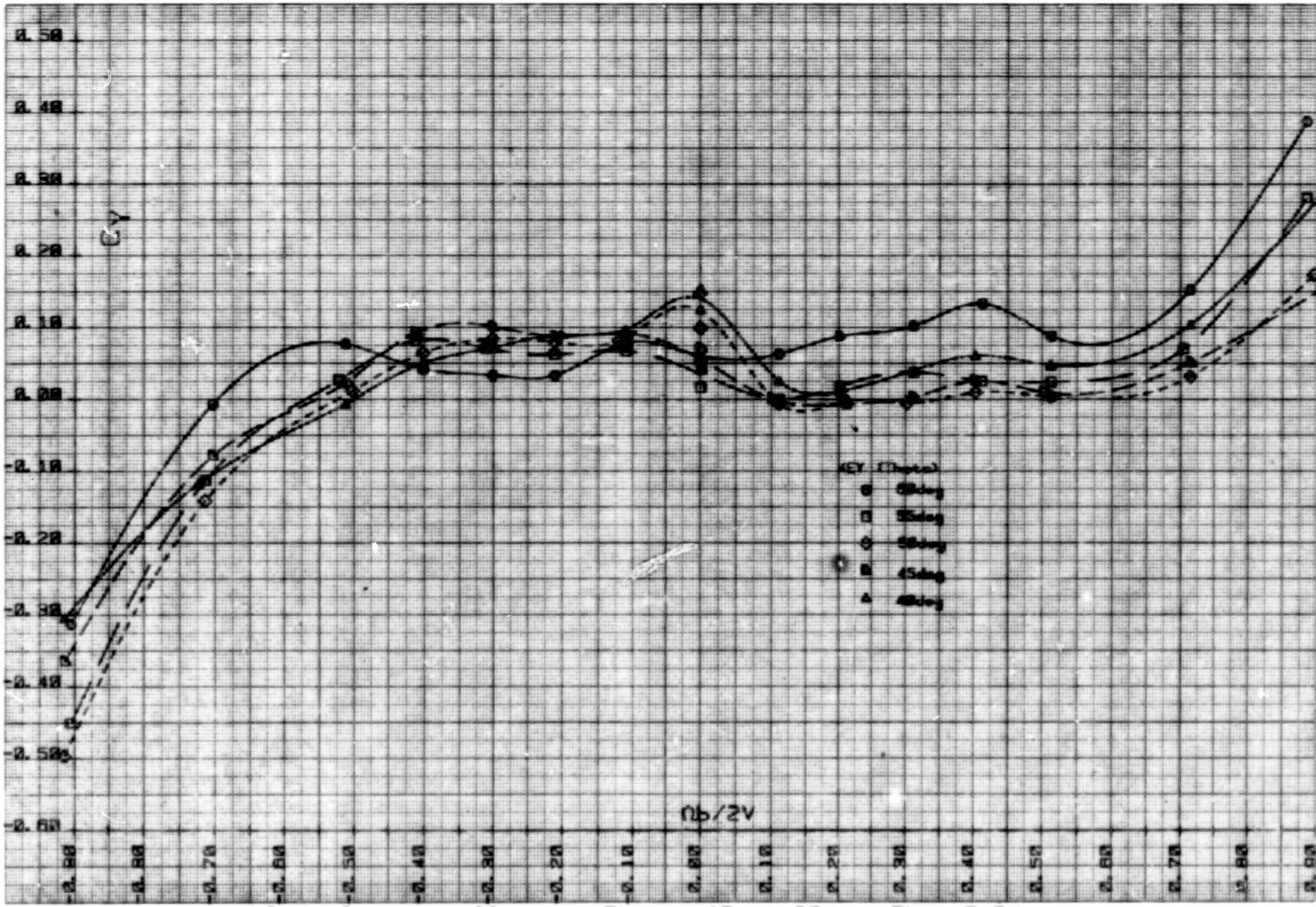


.) Normal-force coefficient, Theta= 15 to 35deg; Phi=-0.3deg.

Figure 14.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V 6"SR.



i.) Side-force coefficient, Theta= 40 to 60deg; Phi=-0.3deg.

Figure 14.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V 6"SR.

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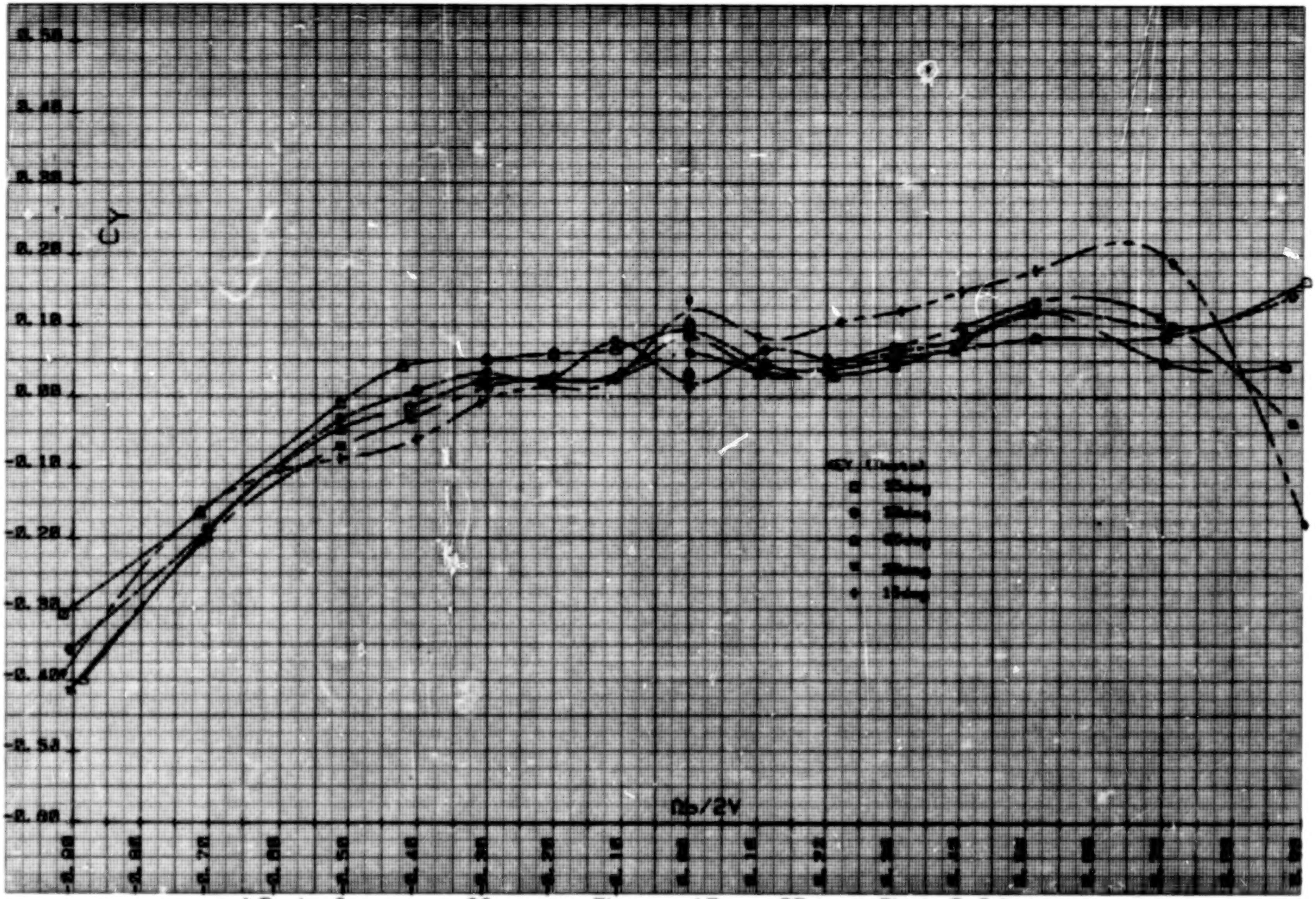
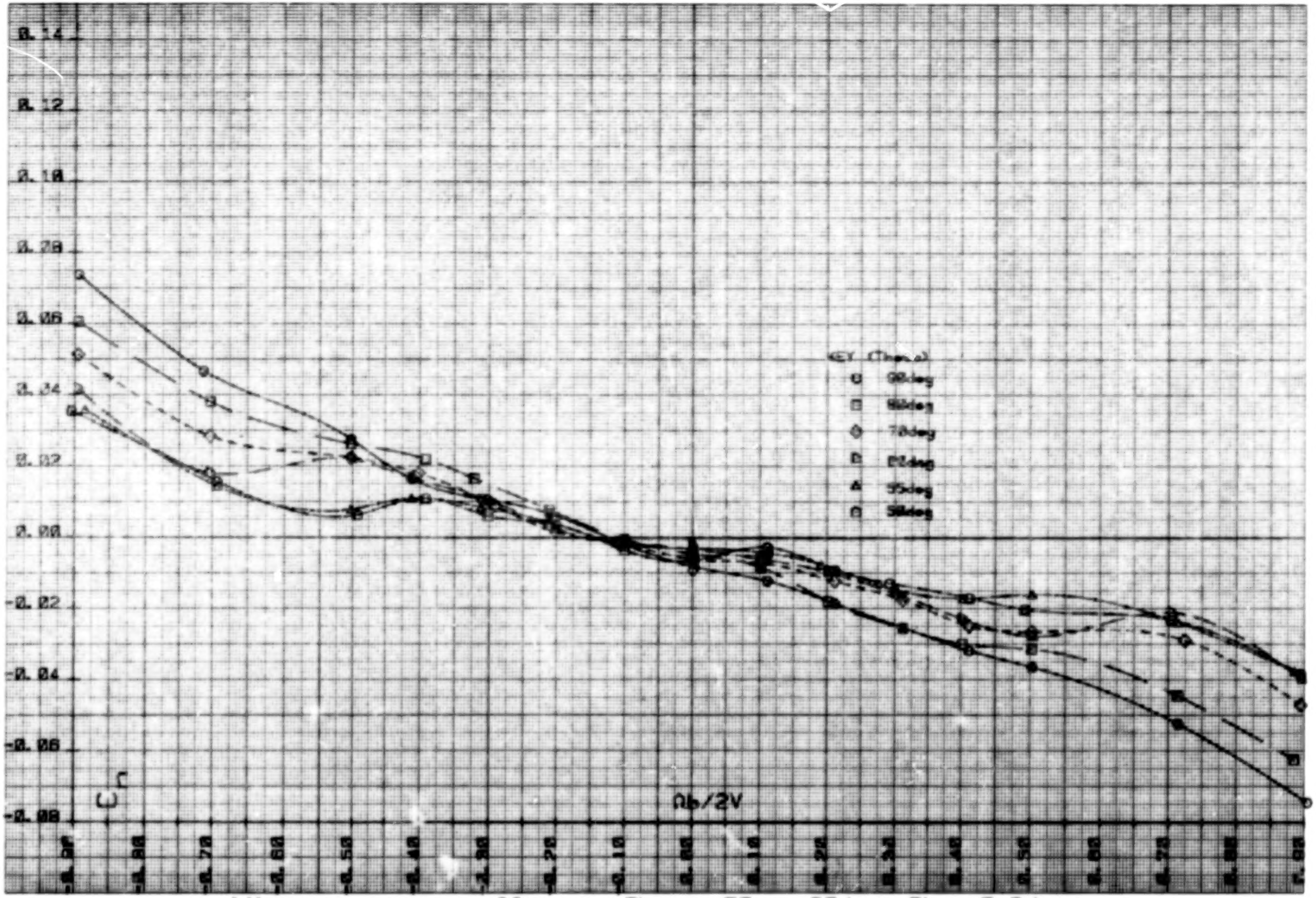


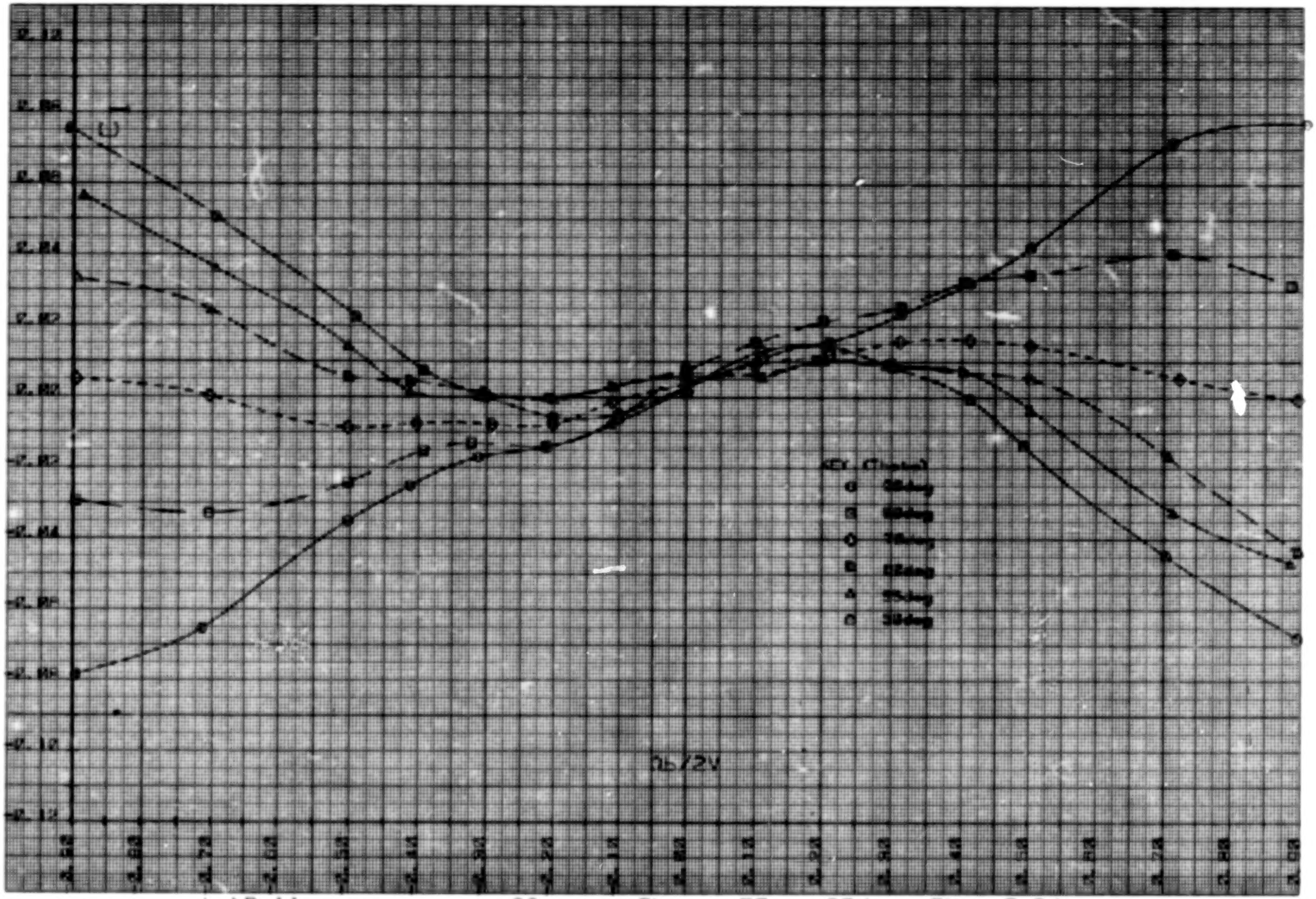
j) Side-force coefficient, Theta= 15 to 35deg; Phi=-0.3deg.

Figure 14.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V 6"SR.



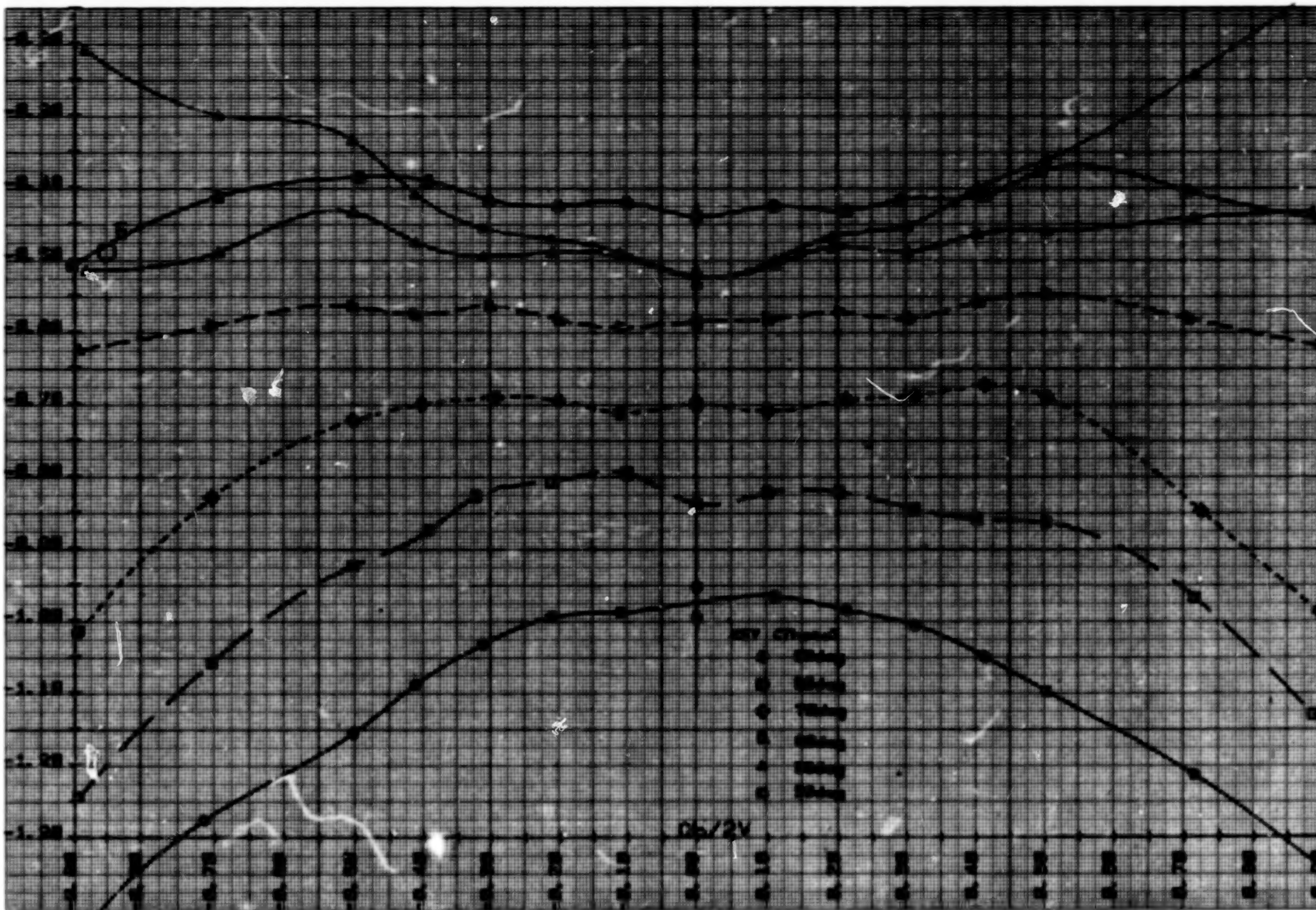
a.) Yawing-moment coefficient, Theta= 50 to 90deg; Phi=-0.3deg.

Figure 15.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V-25e.



b.)Rolling-moment coefficient, Theta= 50 to 90deg; Phi=-0.3deg.

Figure 15.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V-25e.



c.) Pitching-moment coefficient, Theta= 50 to 90deg; Phi=-0.4deg.

Figure 15. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V-25e.

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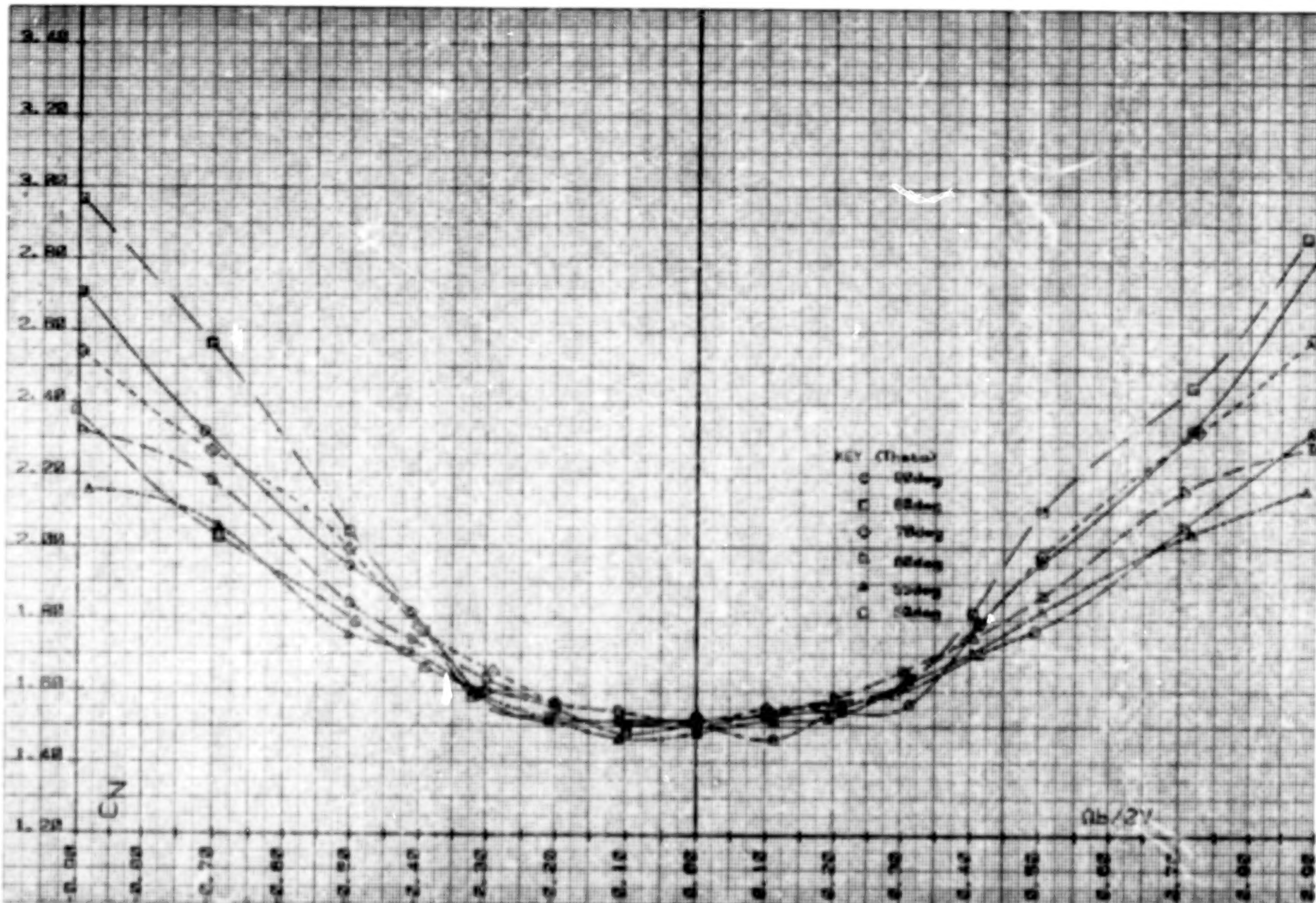
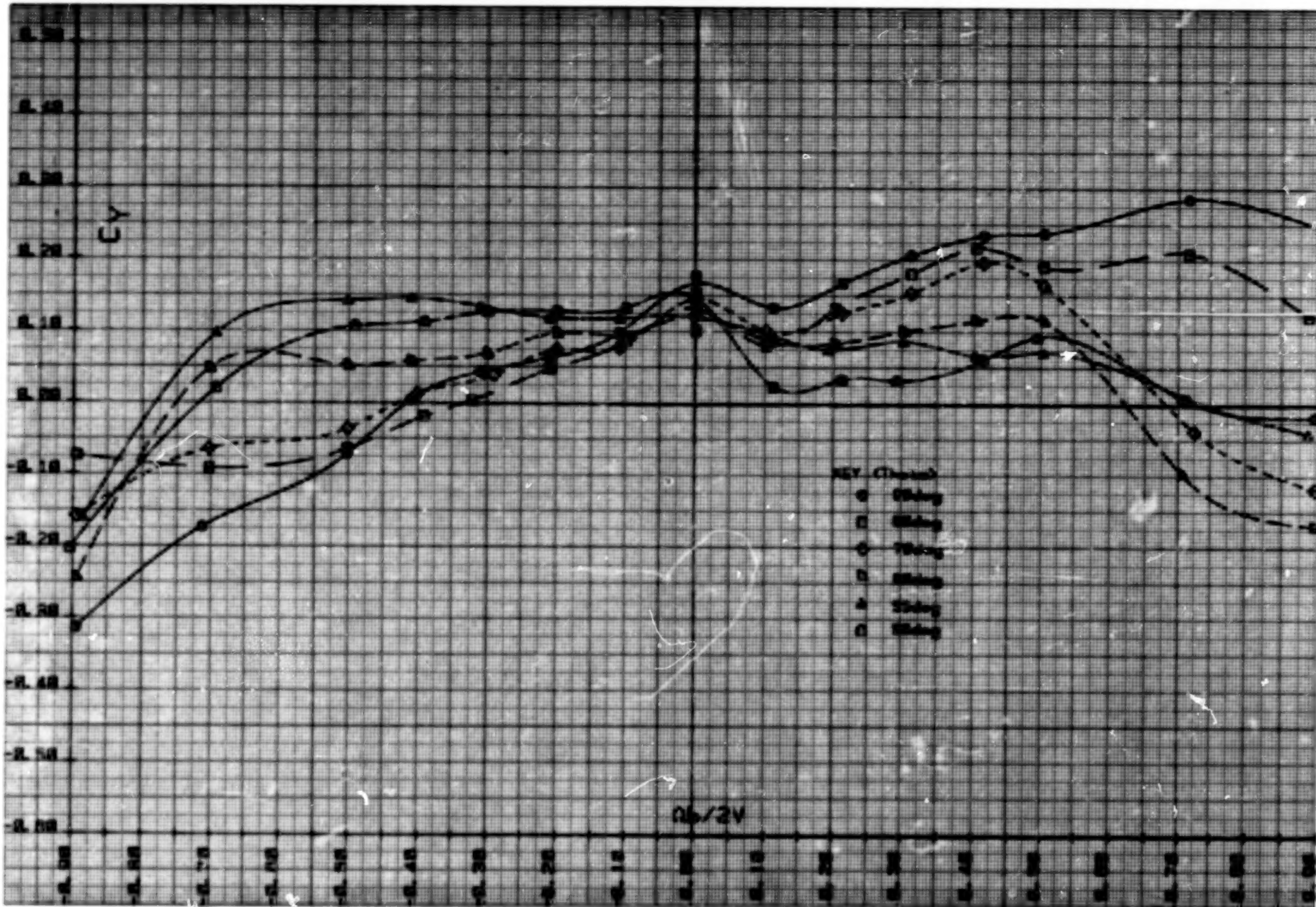


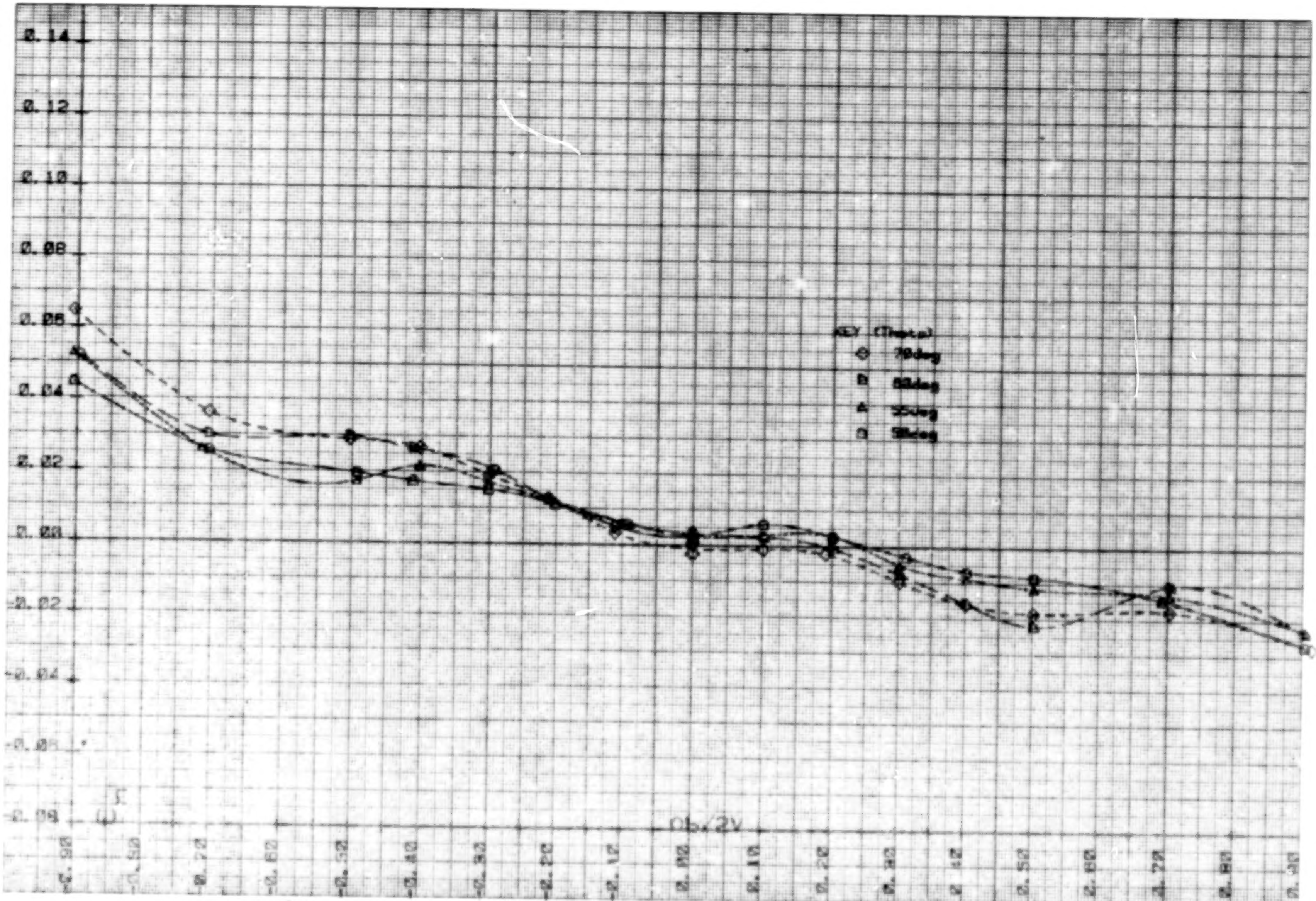
d.) Normal-force coefficient, Theta= 5Ø to 9Ødeg; Phi=-Ø.4deg.

Figure 15. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V-25e.



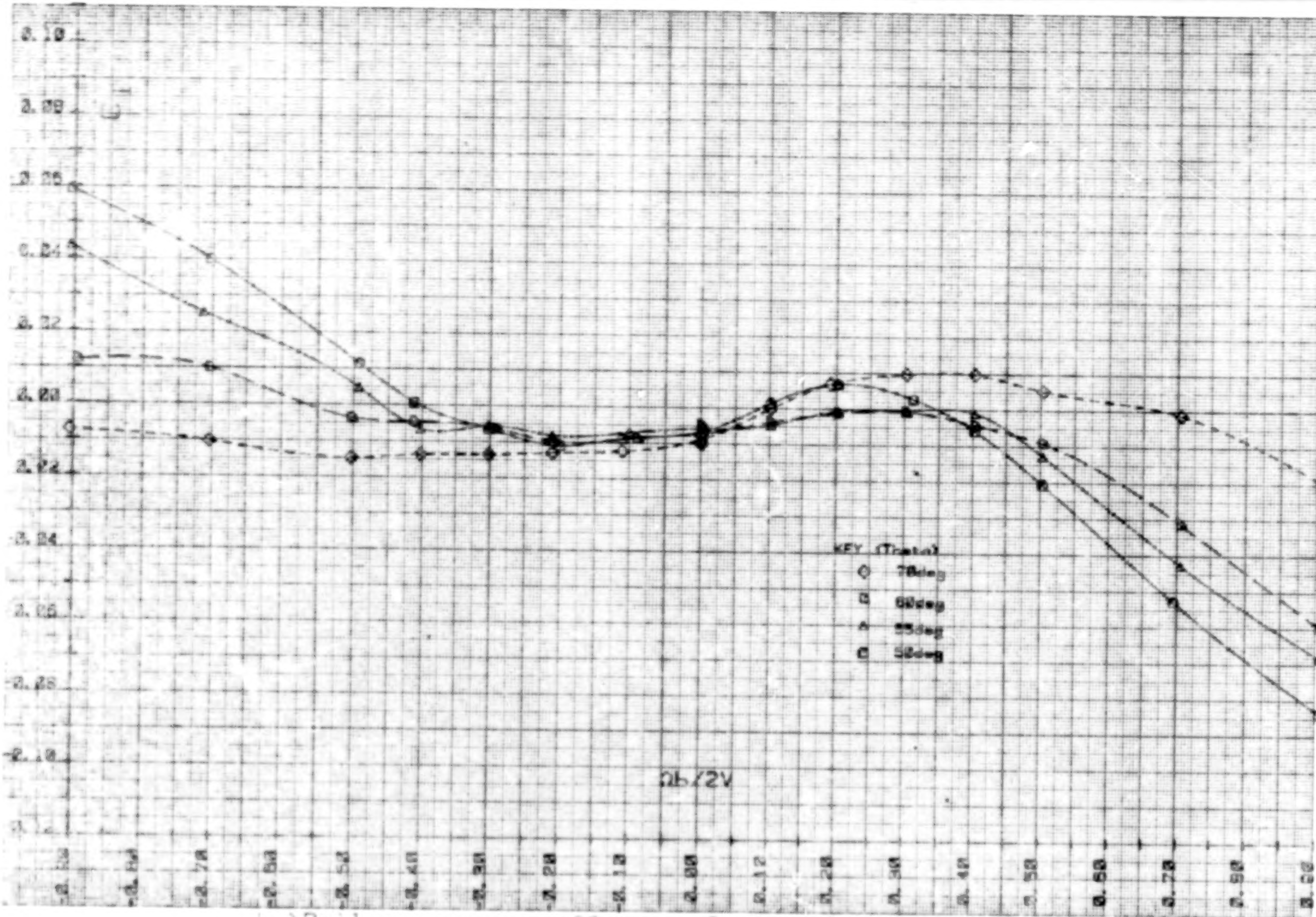
e.) Side-force coefficient, Theta= 50 to 90deg; Phi=-0.4deg.

Figure 15. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V-25e.



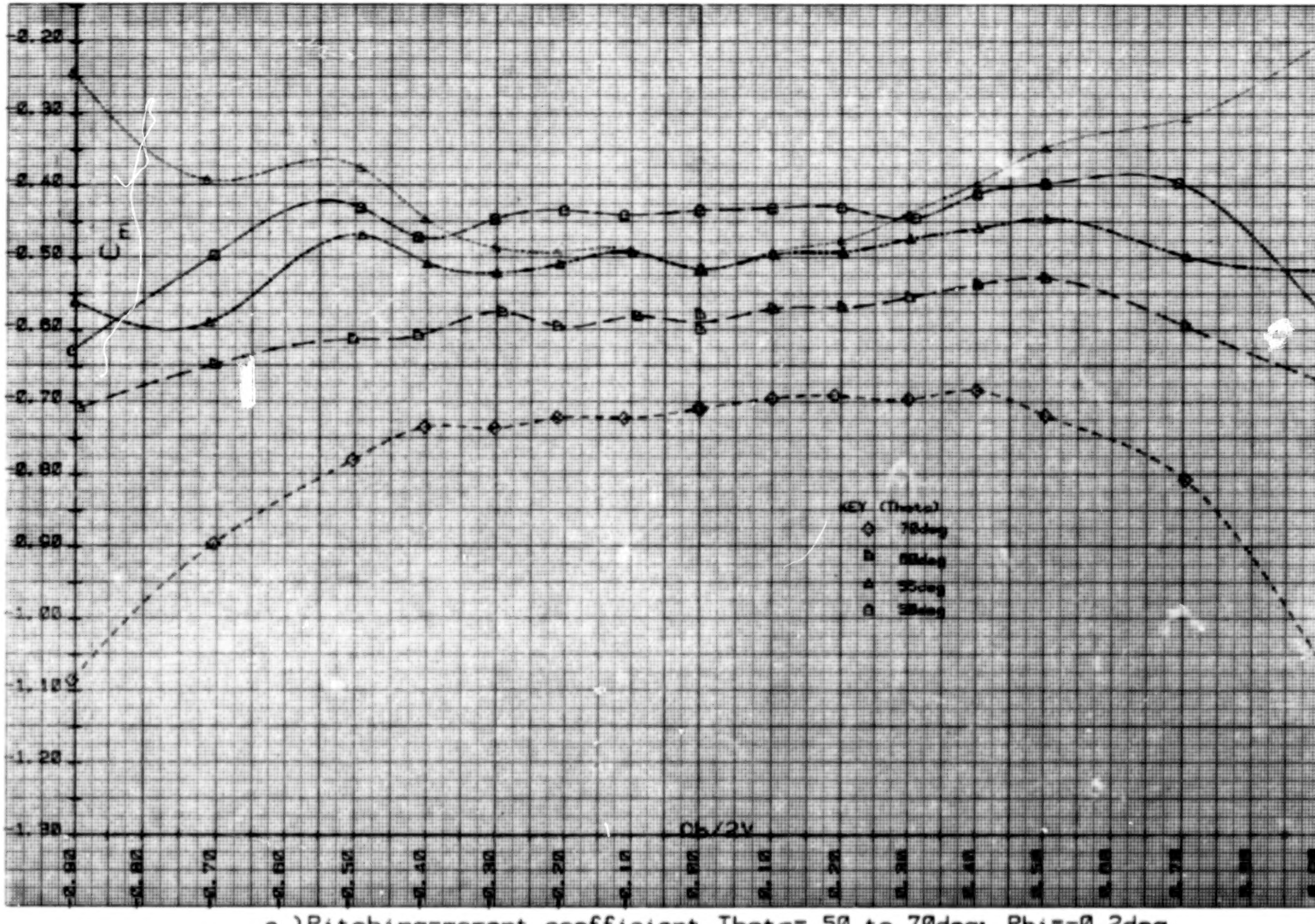
a.) Yawing-moment coefficient, Theta= 5Ø to 7Ødeg; Phi=-Ø.1deg.

Figure 18.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V-25e-25r.



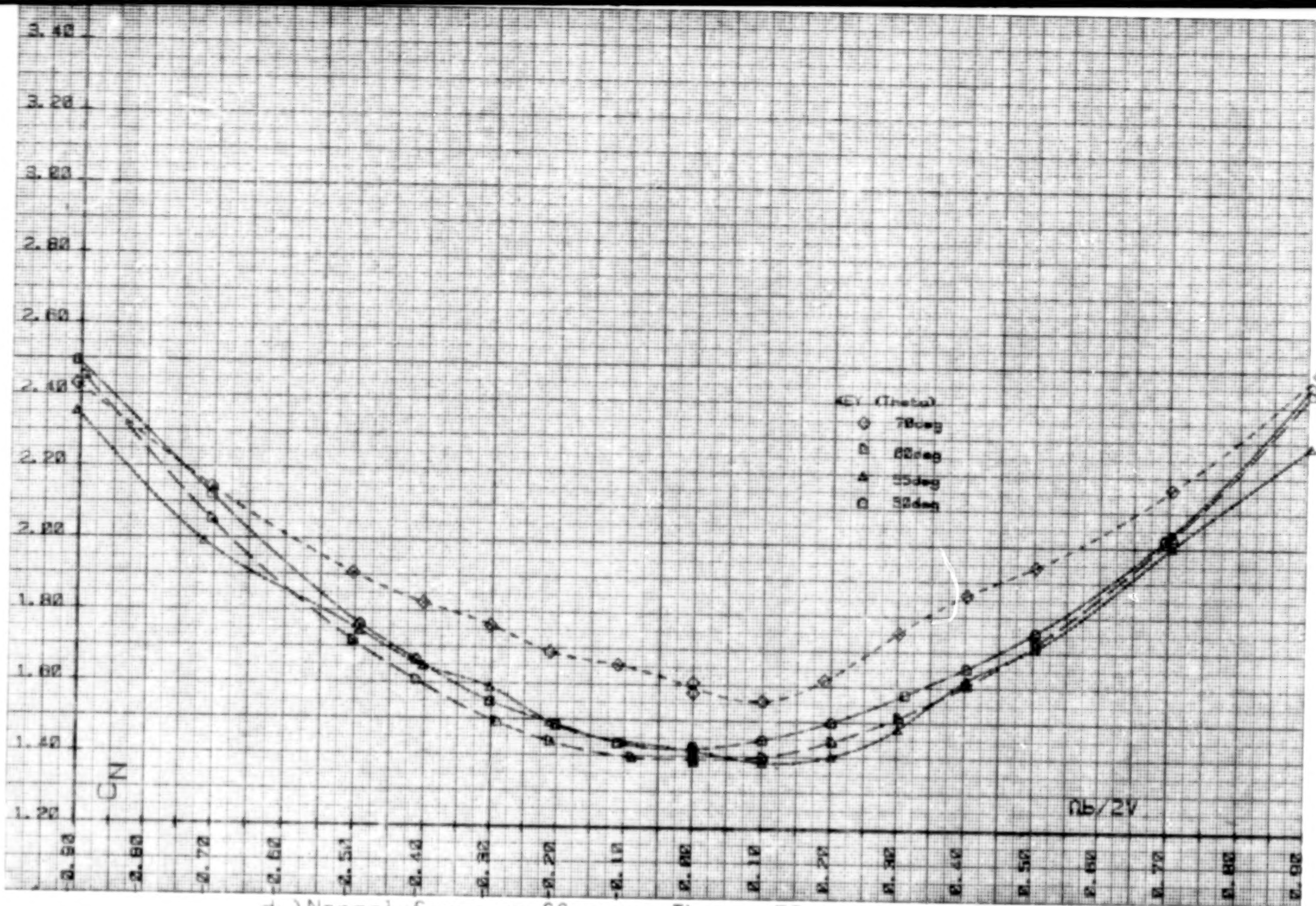
b.) Rolling-moment coefficient, Theta= 50 to 70deg; Phi=-0.1deg.

Figure 18.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V-25e-25r.



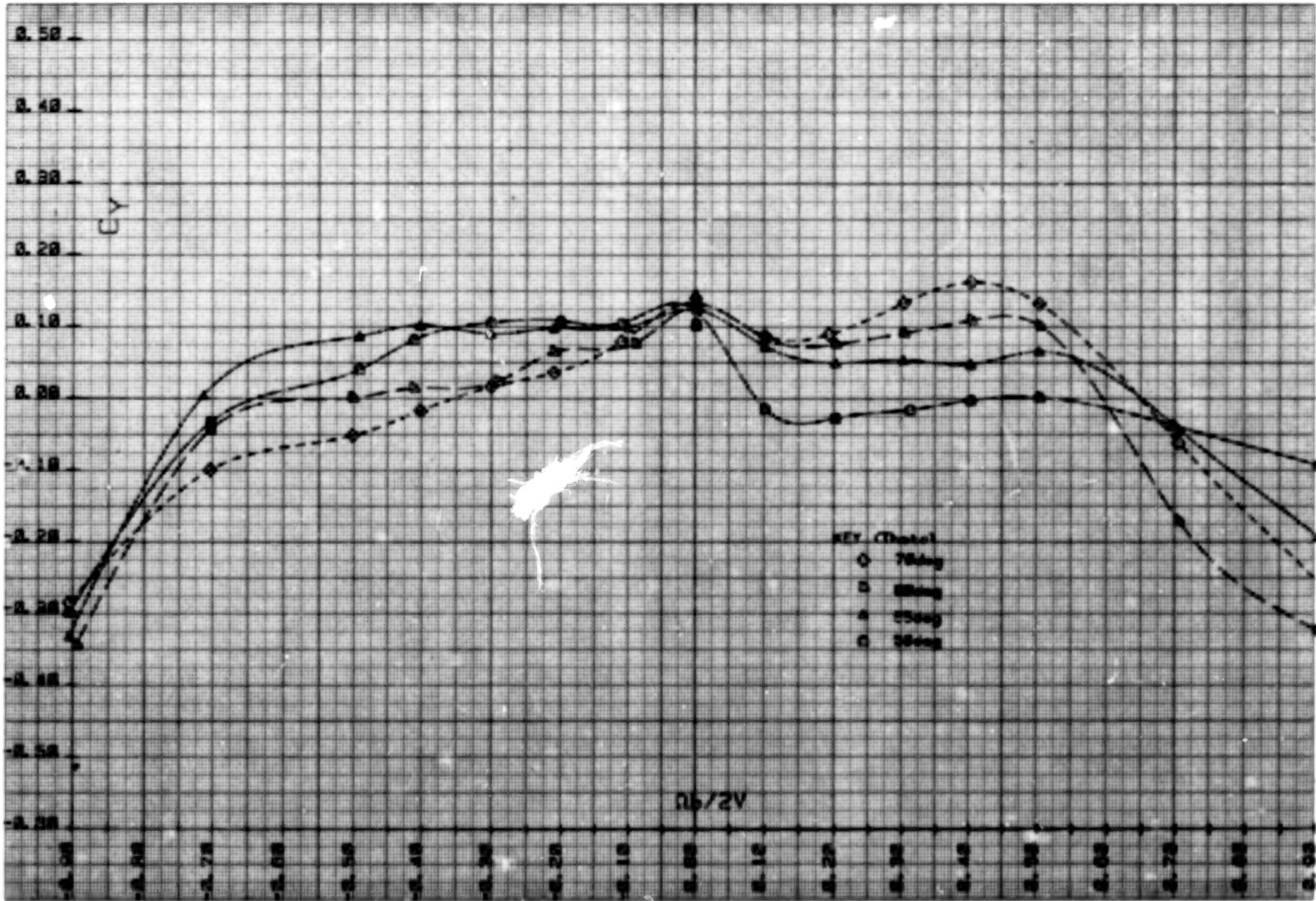
c.) Pitching-moment coefficient, Theta= 50 to 70deg; Phi=-0.2deg.

Figure 16. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V-25e-25r.



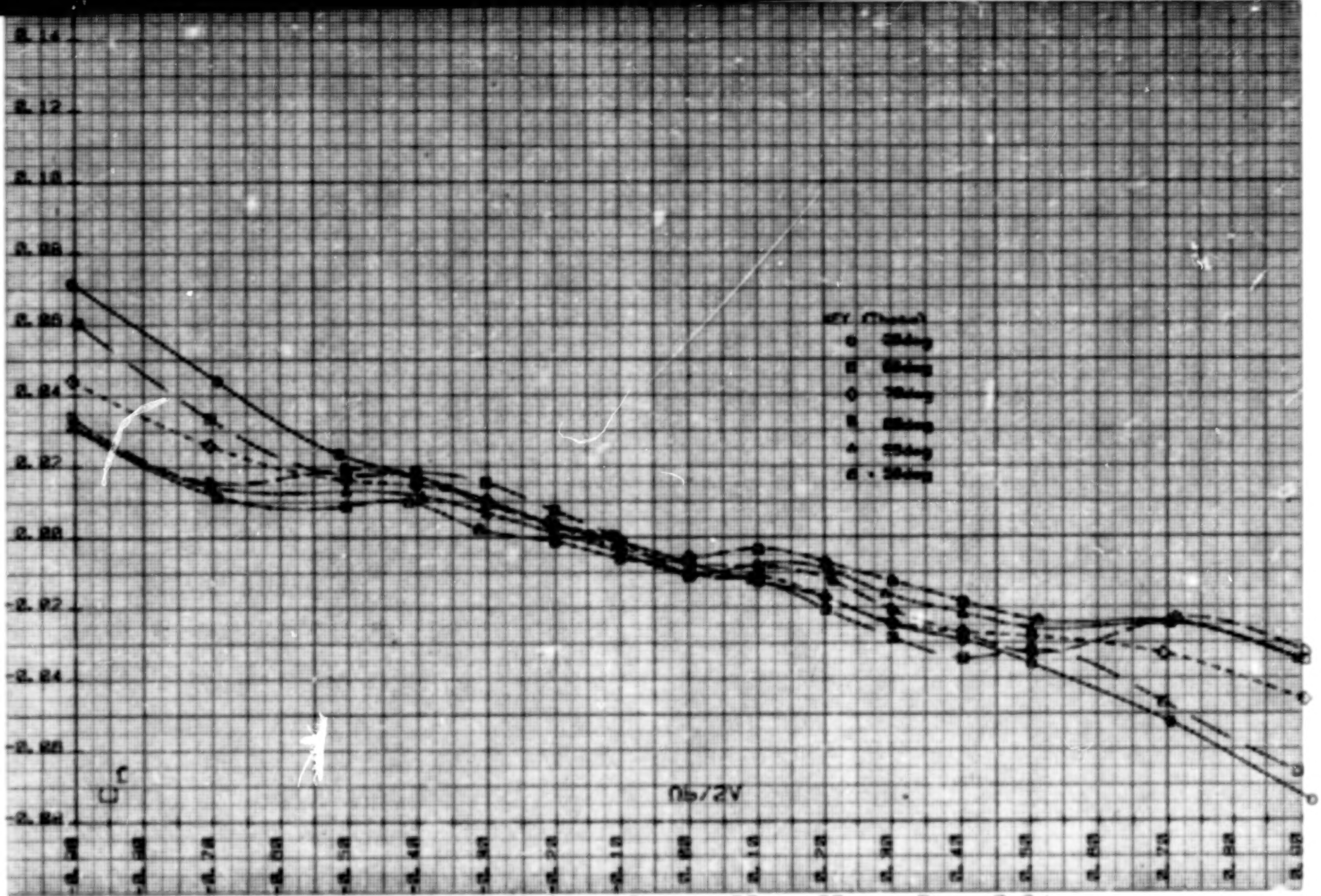
d.) Normal-force coefficient, Theta= 50 to 70deg: Phi=-0.2deg.

Figure 16.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V-25e-25r.



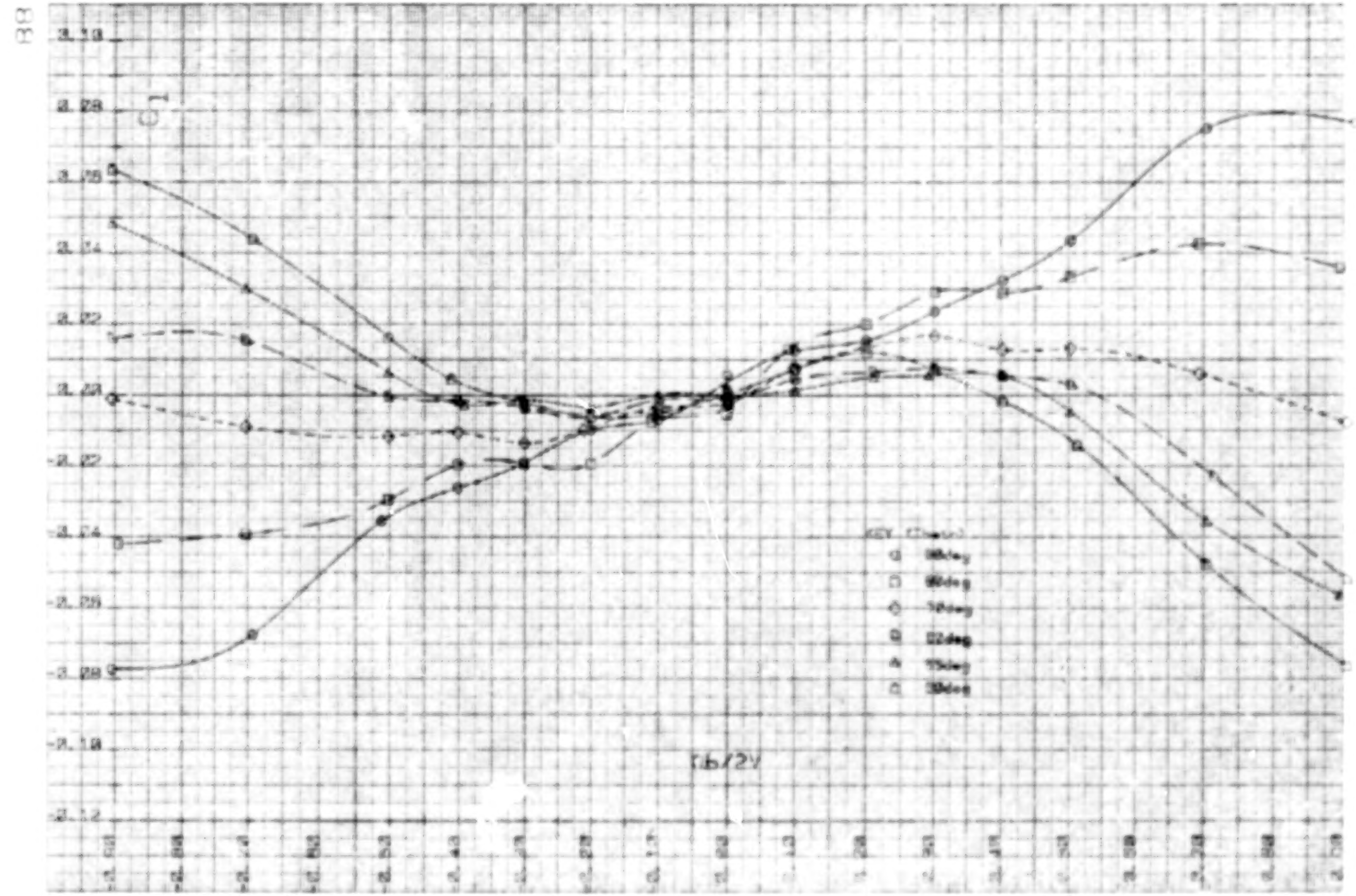
e.) Side-force coefficient, Theta= 50 to 70deg; Phi=-0.1deg.

Figure 16.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V-25e-25r.



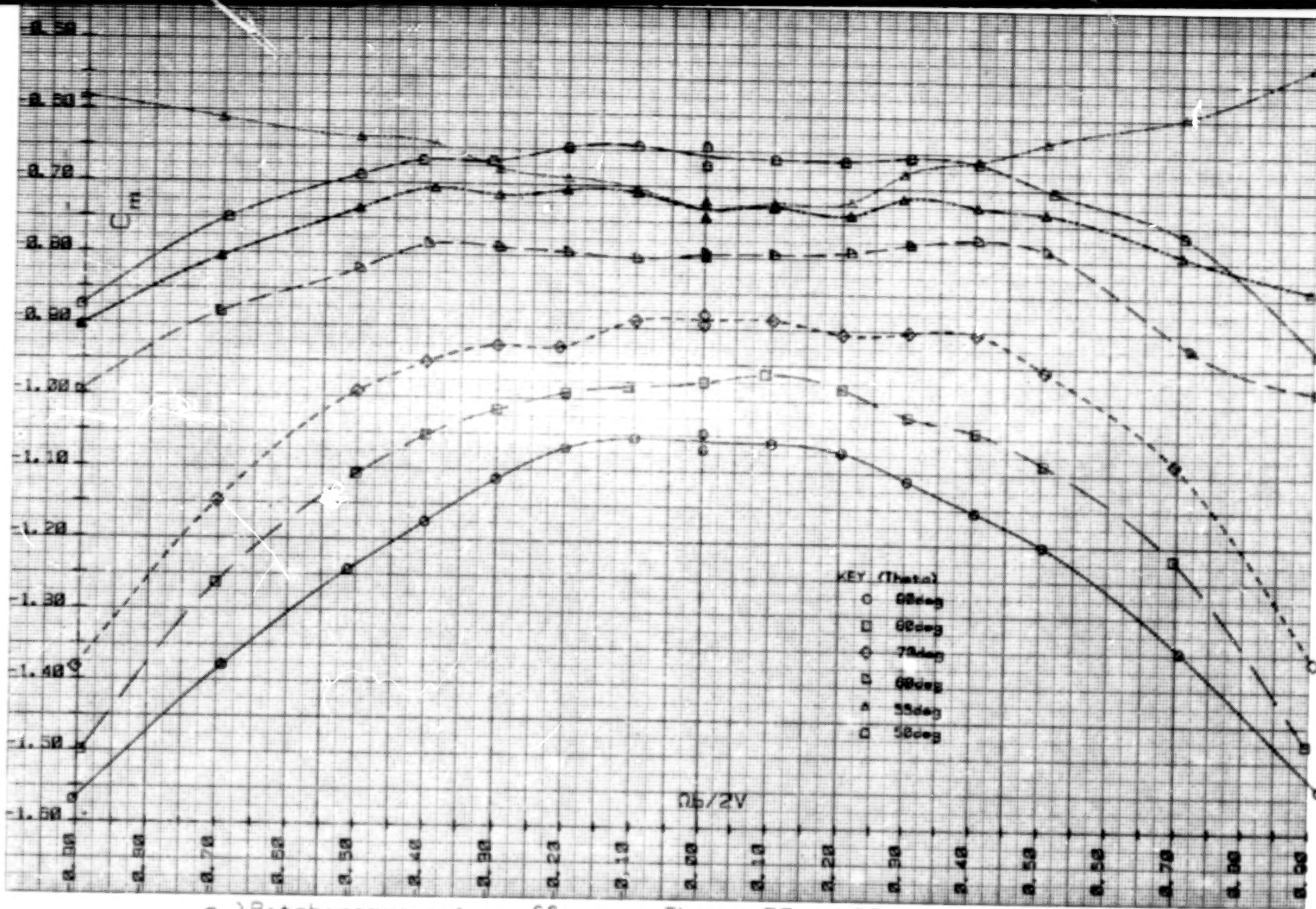
a.) Yawing-moment coefficient, Theta= 50 to 90deg; Phi=-0.2deg.

Figure 17.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V+15e.



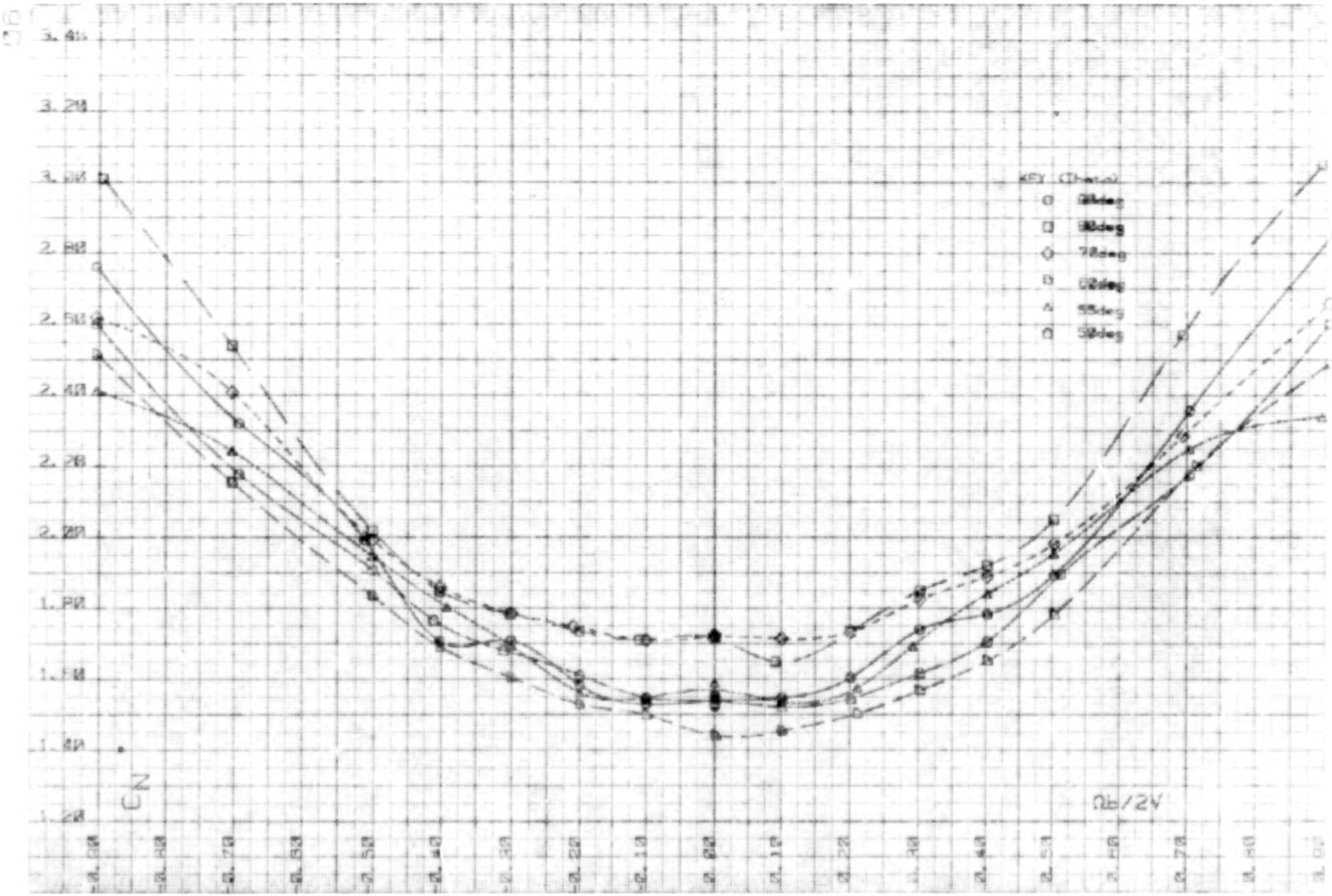
b.) Rolling-moment coefficient, theta= [illegible] to [illegible]deg; Pitch [illegible]deg.

Figure 17.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BWIH6V+15e.



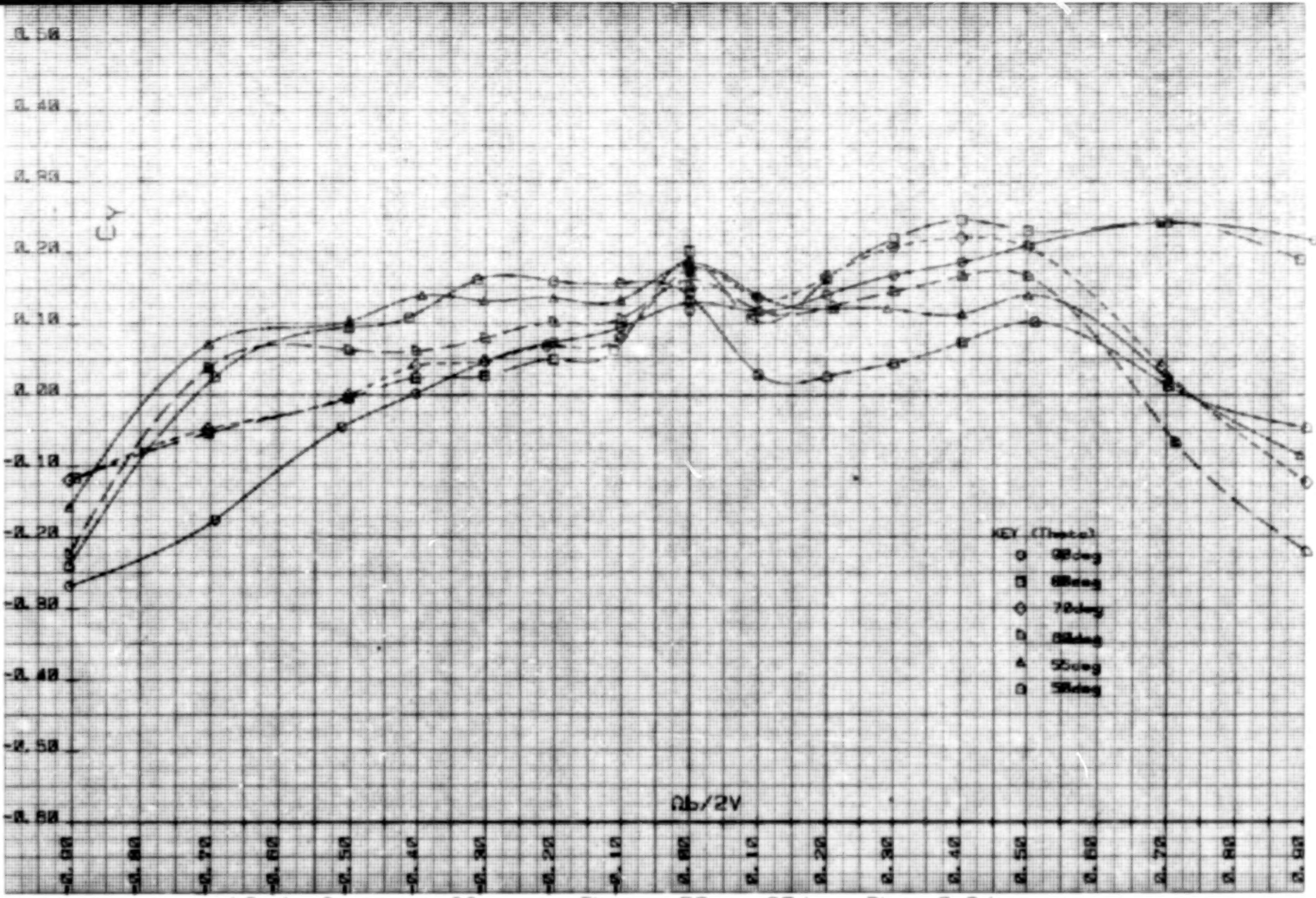
c.) Pitching-moment coefficient. Theta= 50 to 90deg; Phi=-0.3deg.

Figure 17.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V+15e.



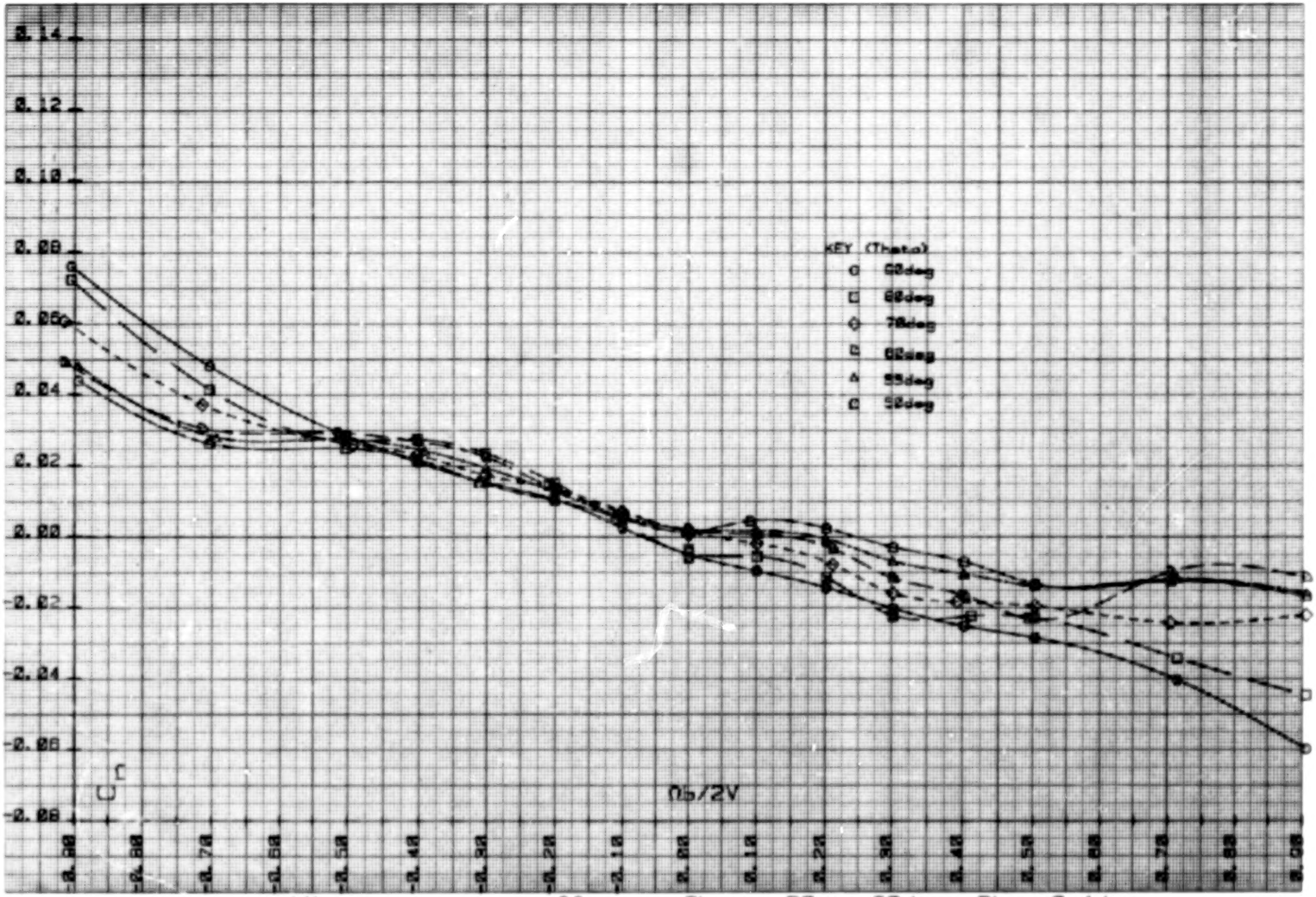
d.) Normal-force coefficient, Theta= 50 to 90deg; Phi= -0.2deg.

Figure 17.- Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V+15e.



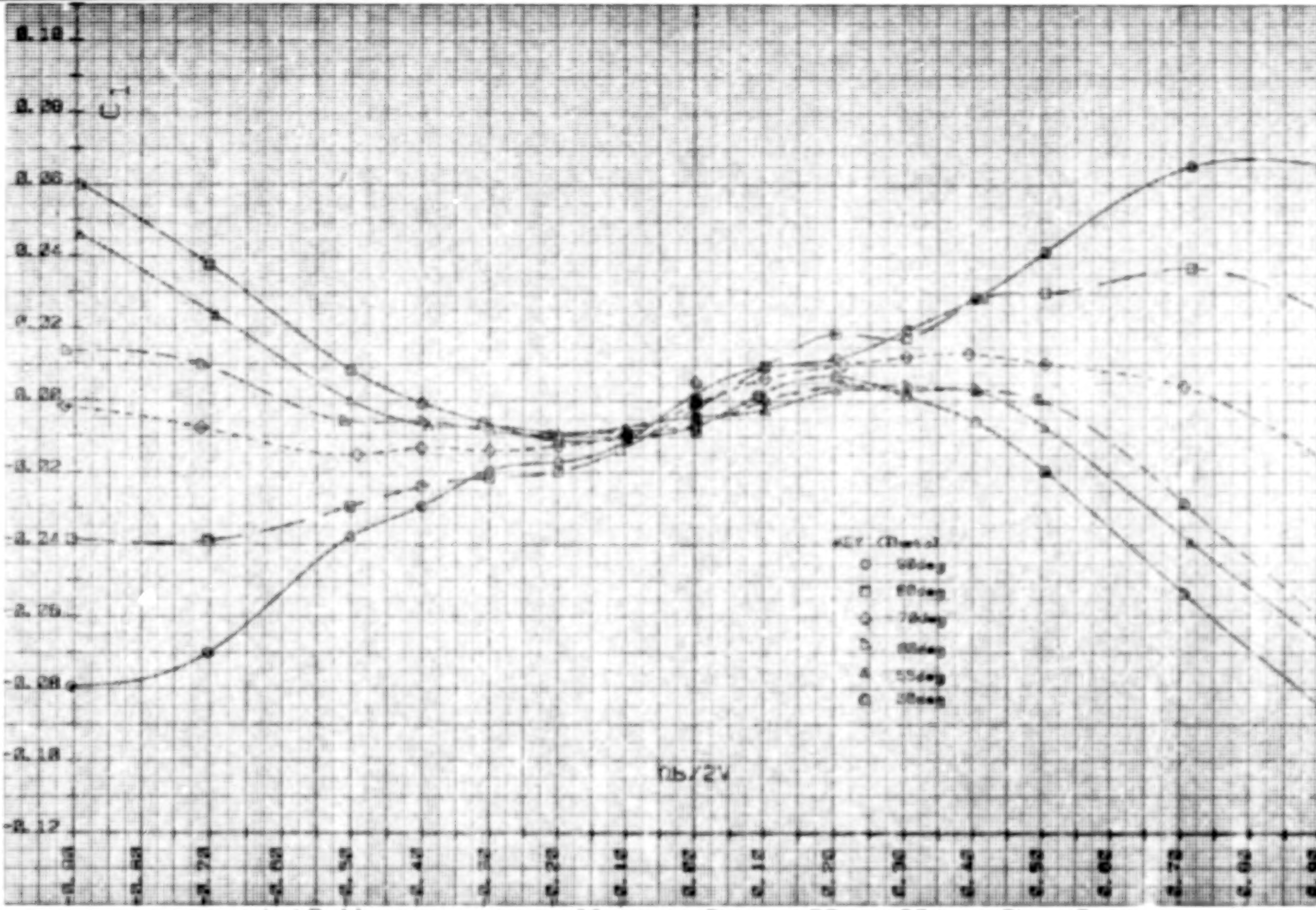
e.) Side-force coefficient, Theta= 50 to 90deg; Phi=-0.3deg.

Figure 17.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V+15e.



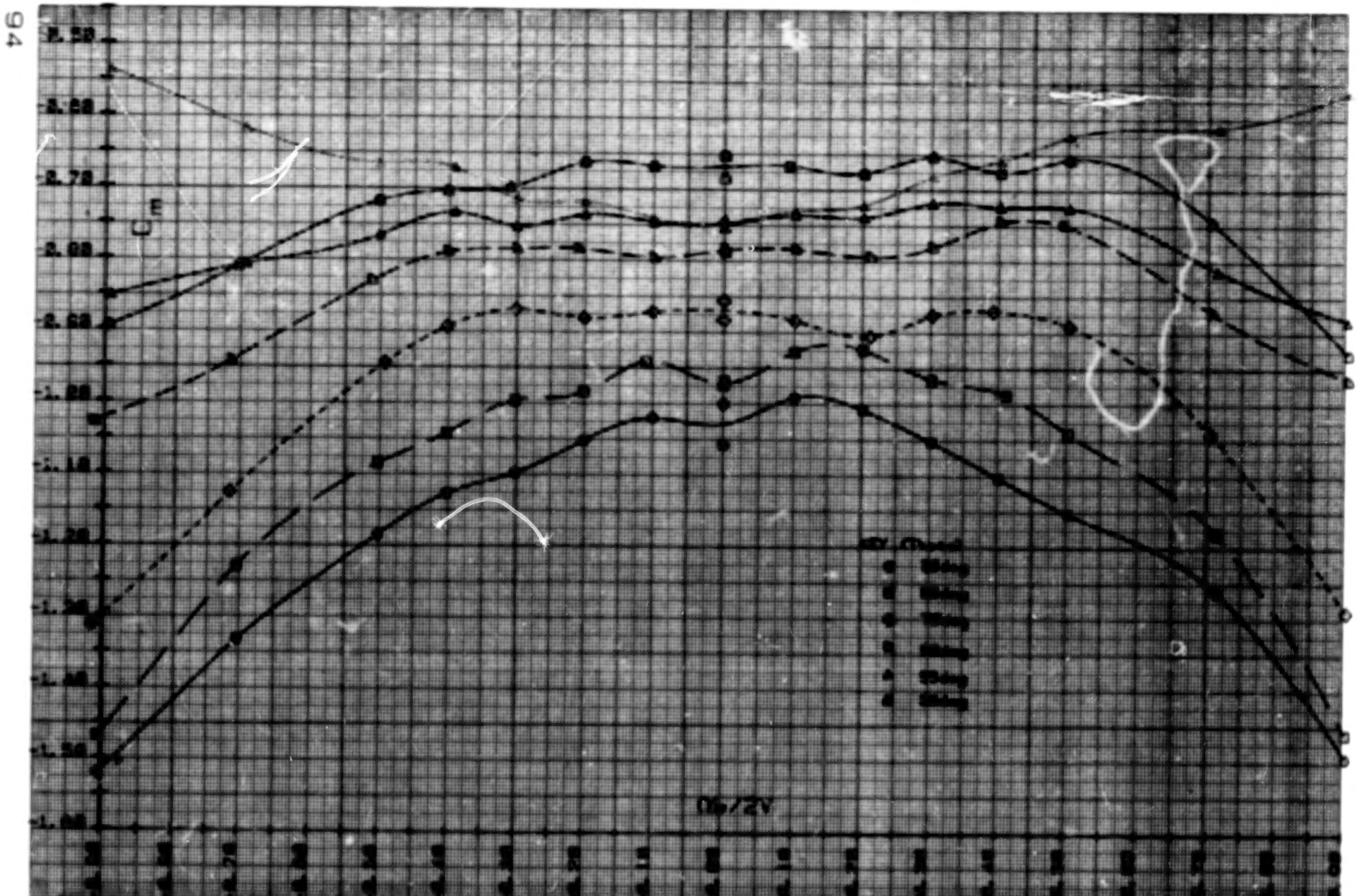
a.) Yawing-moment coefficient, Theta= 50 to 90deg; Phi=-0.4deg.

Figure 18.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V+15e-25r.



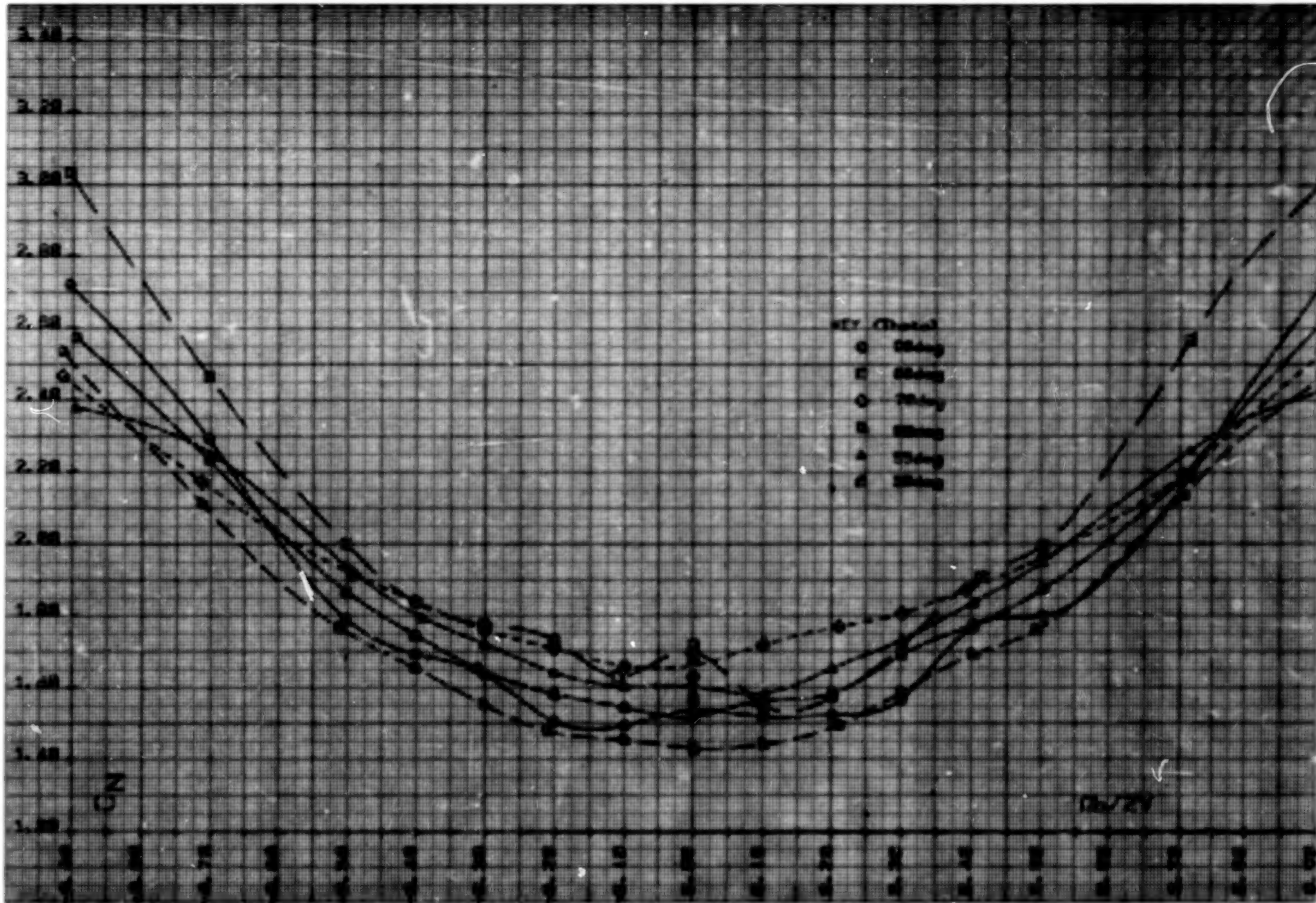
b.) Rolling-moment coefficient, Theta= 50 to 90deg; Phi=-0.4deg.

Figure 18.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V+15e-25r.



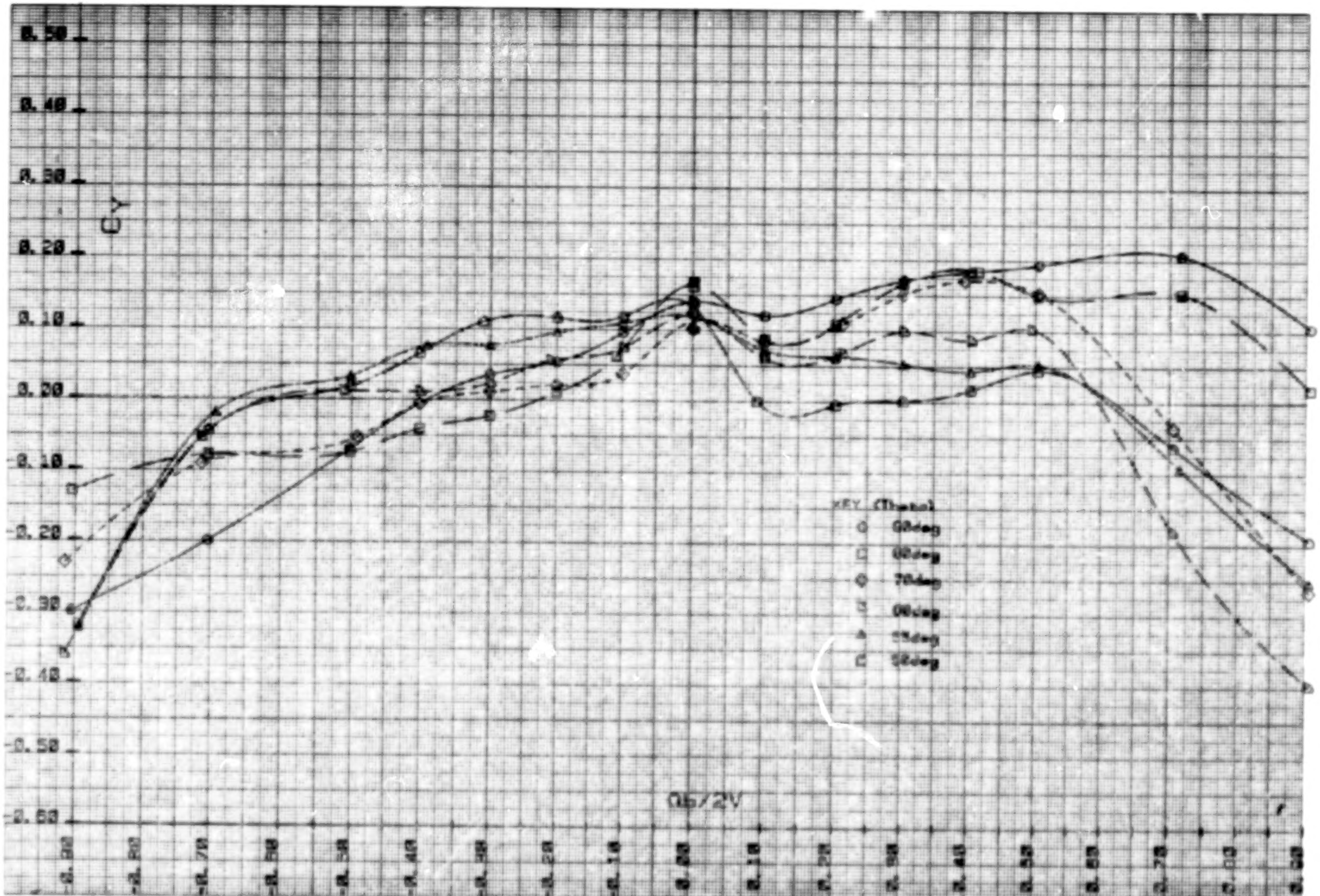
c.) Pitching-moment coefficient, Theta= 50 to 90deg; Phi=-0.4deg.

Figure 18. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V+15e-25r.



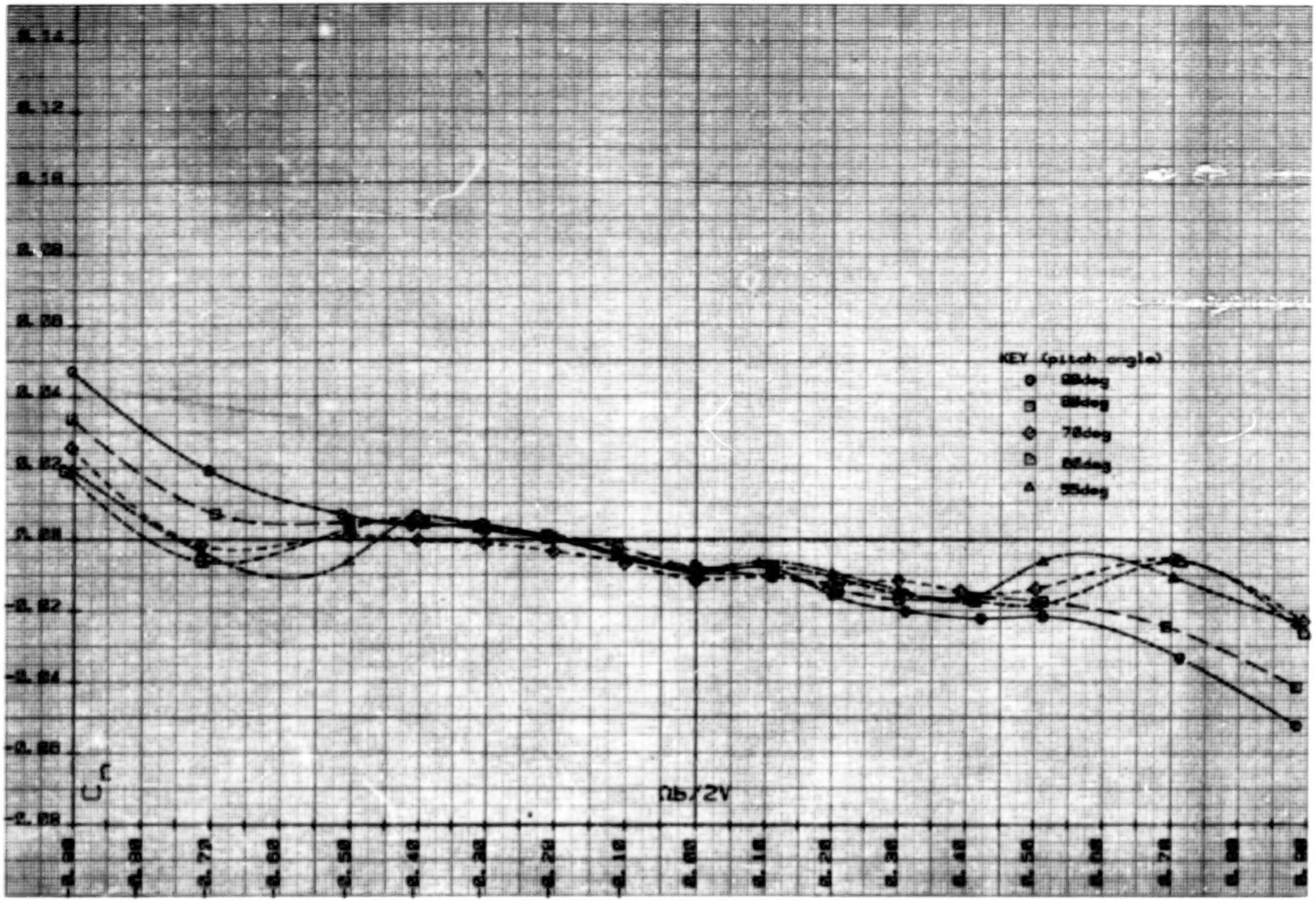
d.) Normal-force coefficient, Theta= 50 to 90deg; Phi=-0.4deg.

Figure 18.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V+15e-25r.



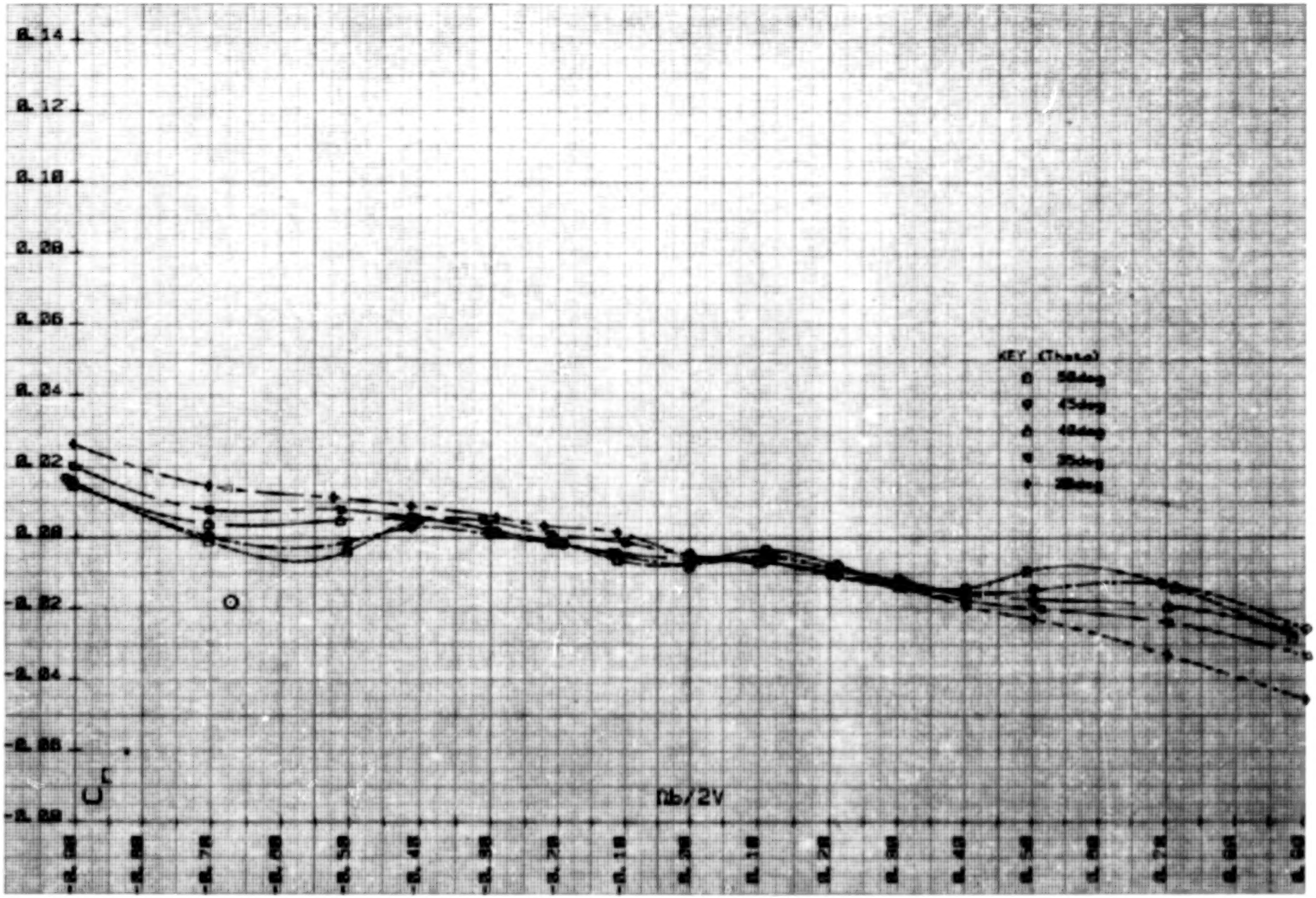
e.) Side-force coefficient, Theta= 50 to 90deg; Phi=-0.4deg.

Figure 18.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H6V+15e-25r.



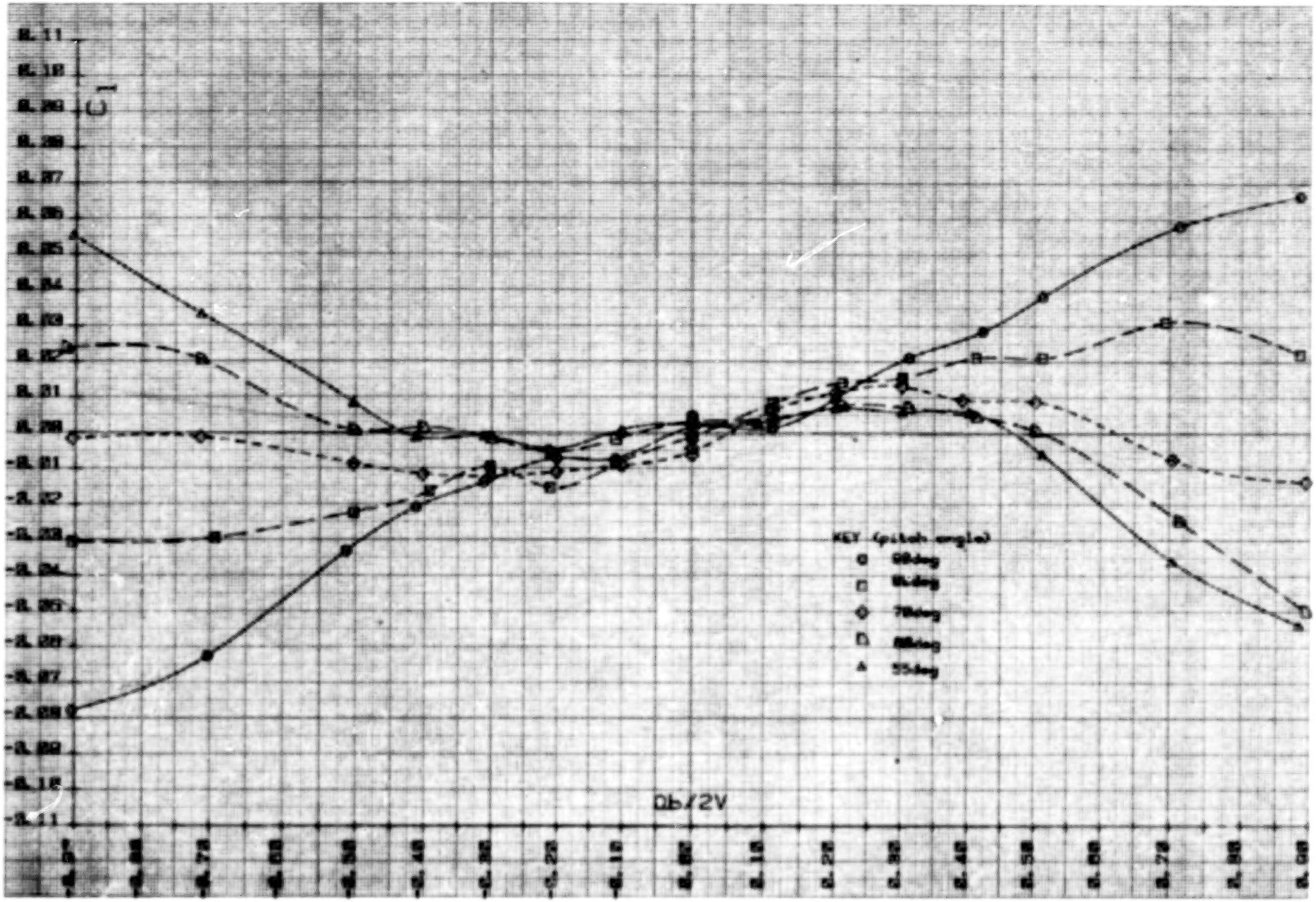
a.) Yawing-moment coefficient. Theta= 55 to 90deg Phi=-0.3deg.

Figure 19.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.



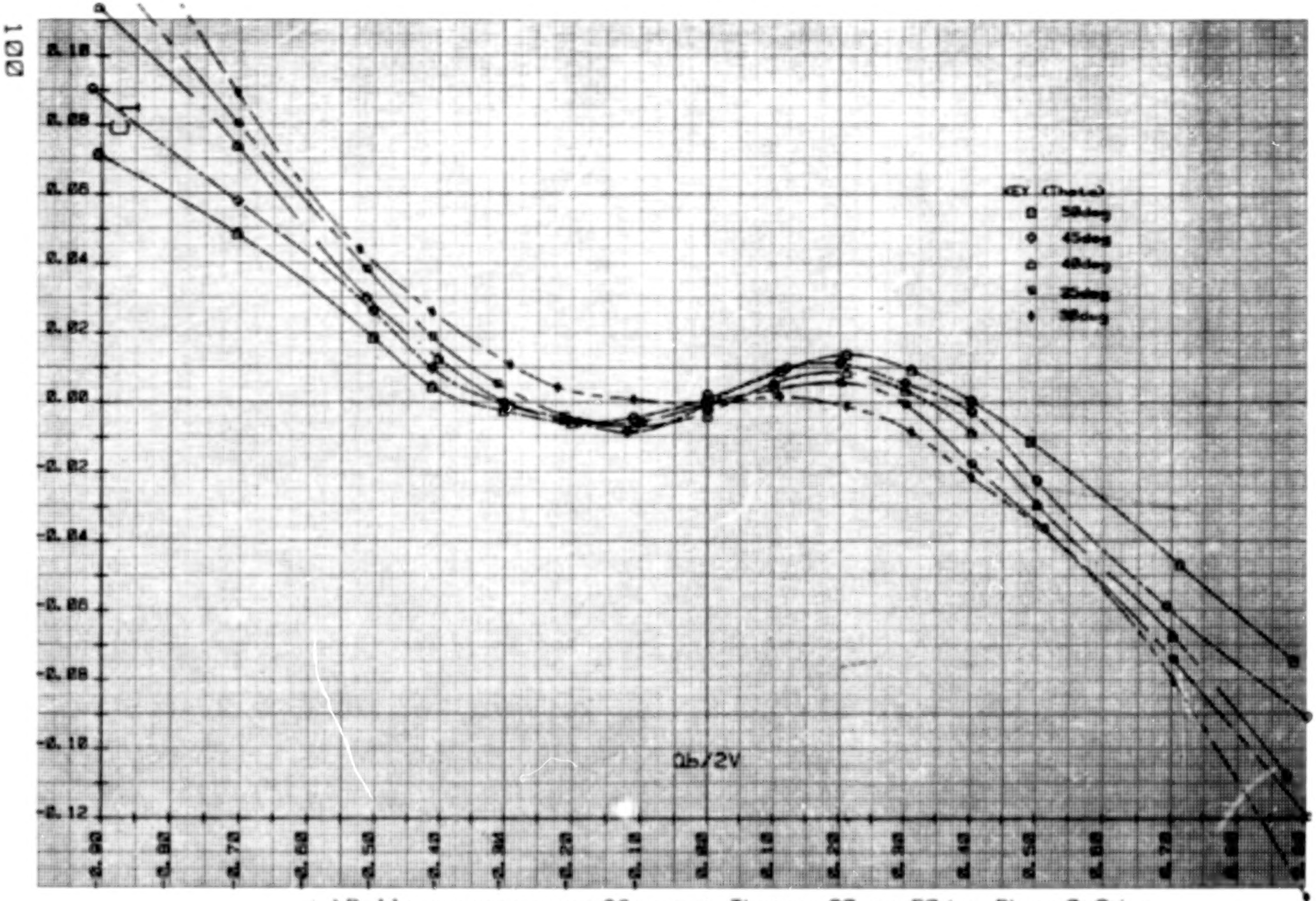
b.) Yawing-moment coefficient, Theta= 30 to 50deg Phi=-0.3deg.

Figure 19.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.



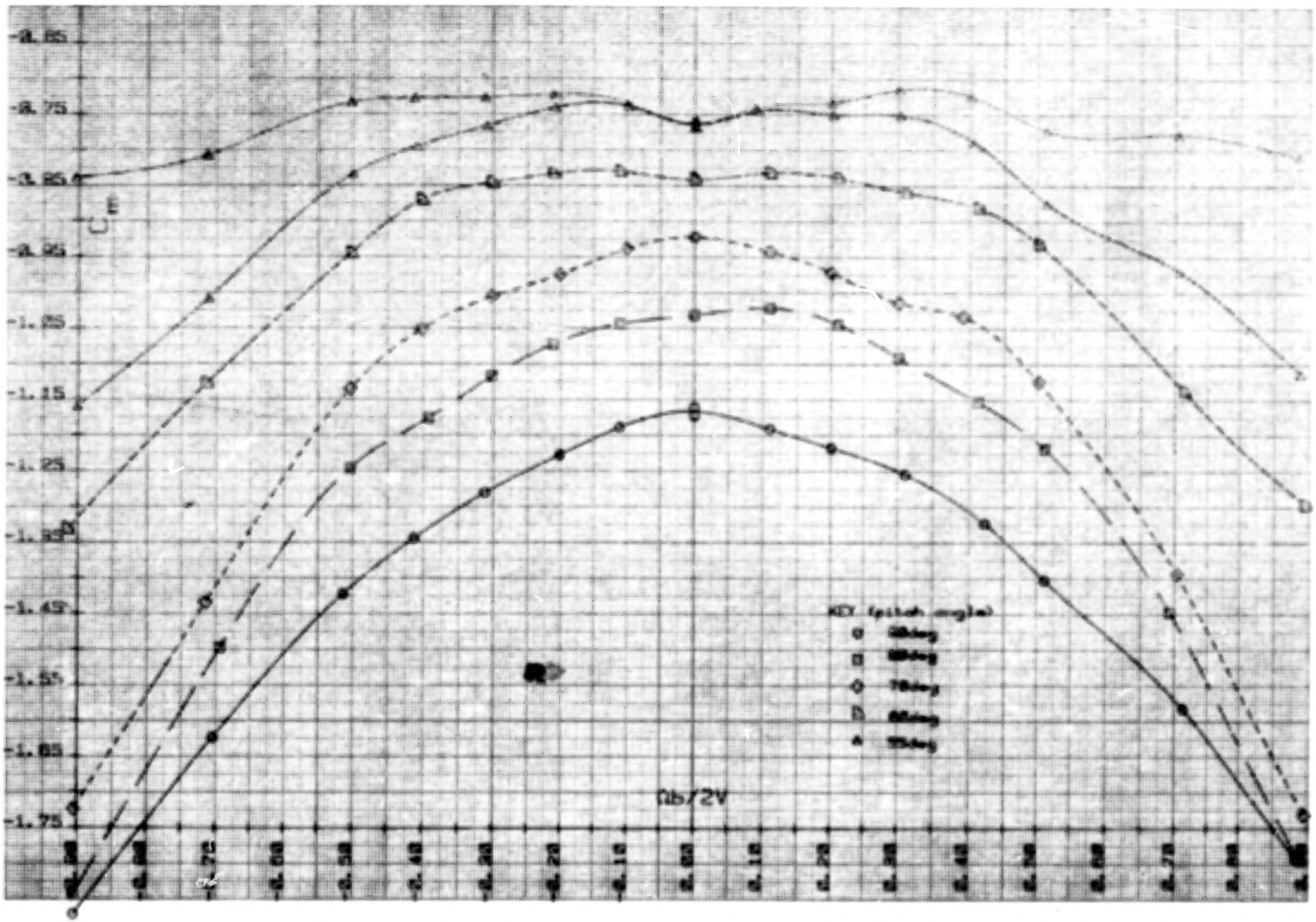
( )Rolling-moment coefficient, Theta= 55 to 90deg Phi=-0.4deg.

Figure 19.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.



d.) Rolling-moment coefficient, Theta= 30 to 50deg Phi=-0.3deg.

Figure 19.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.



a.) Pitching-moment coefficient, Theta= 55 to 90deg Phi=-0.3deg.

Figure 19.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.

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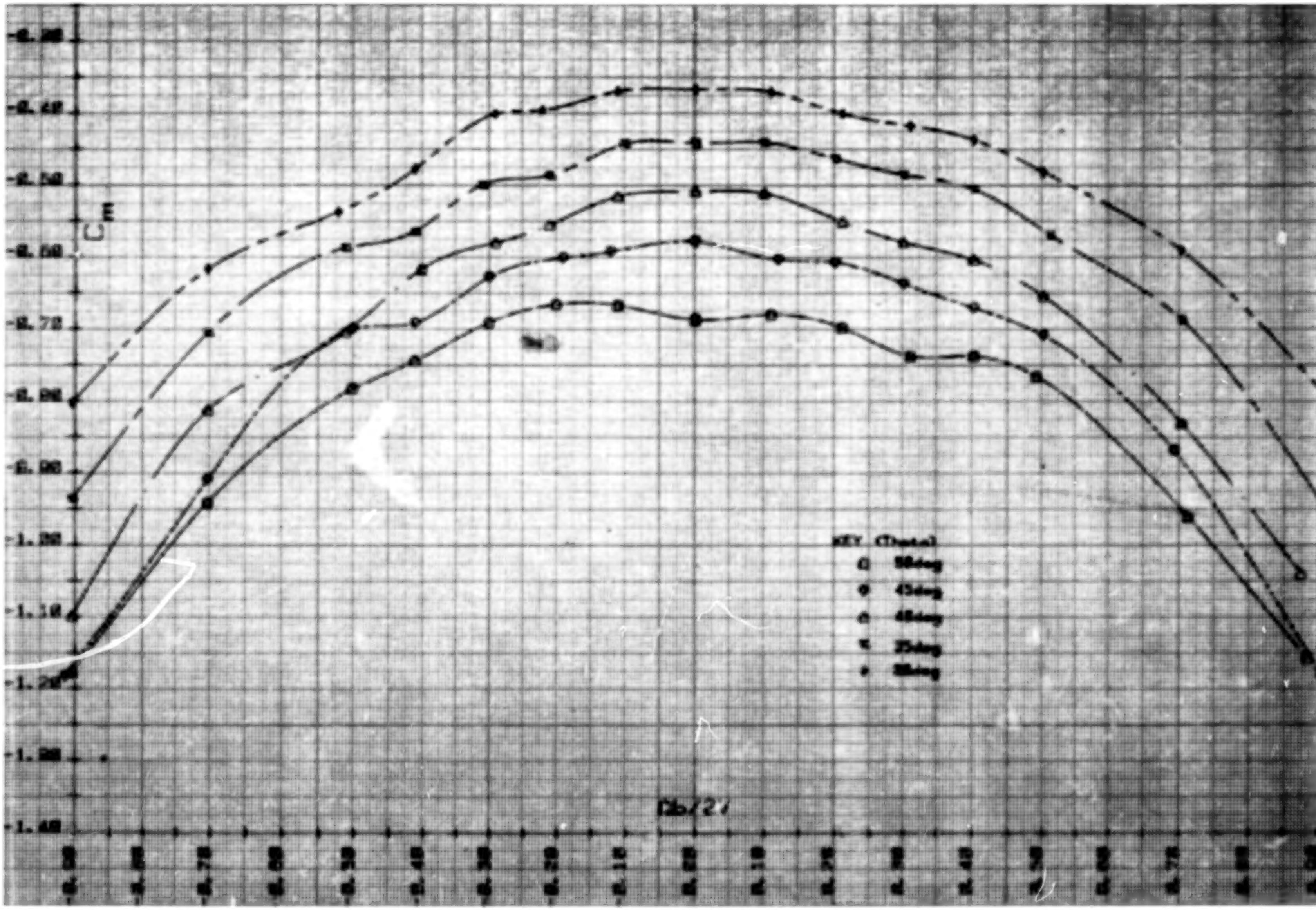
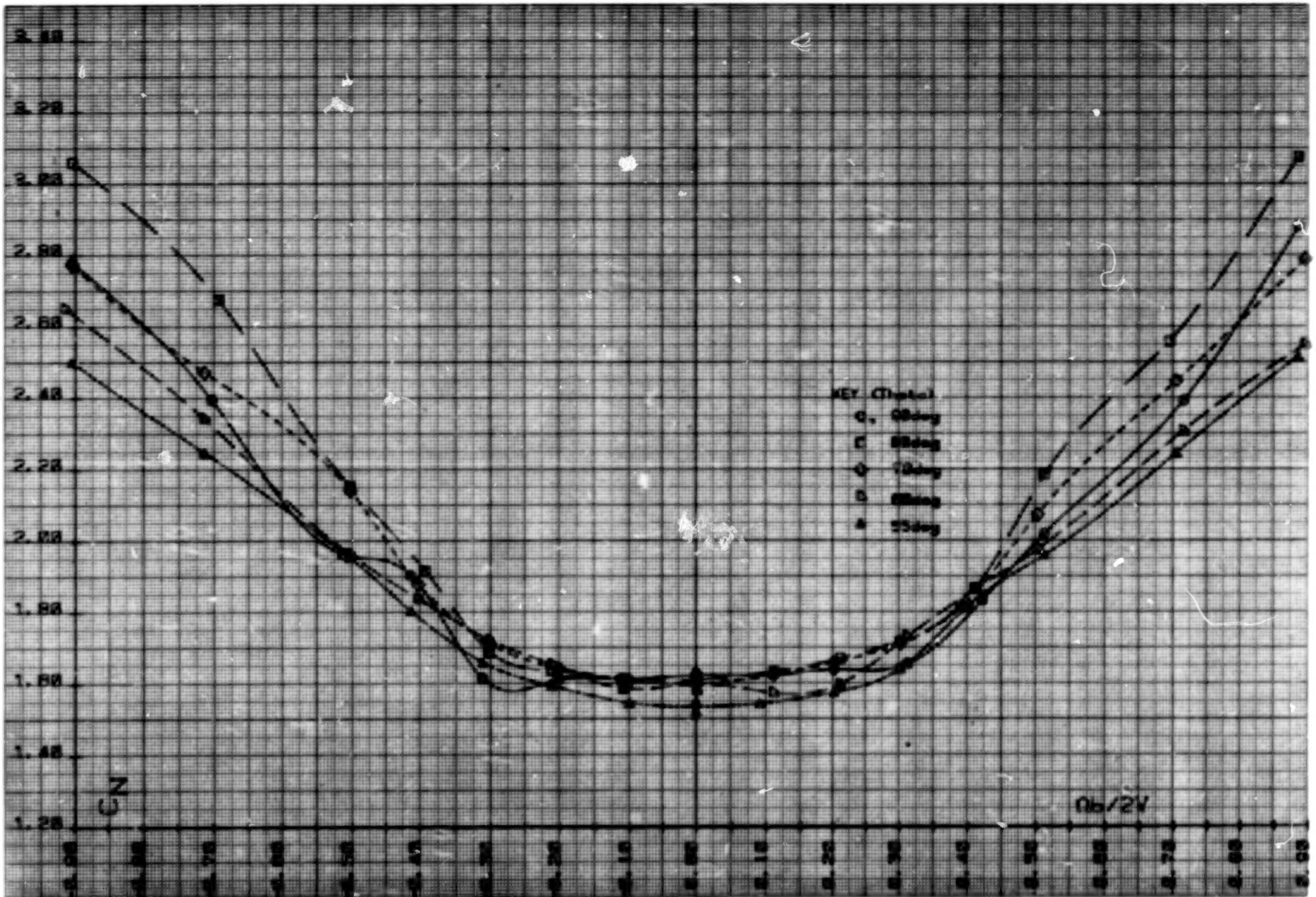


(f.) Pitching-moment coefficient, Theta= 30 to 50deg Phi=-0.3deg.
Figure 19.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.



g.) Normal-force coefficient. Theta= 55 to 90deg; Phi=-0.4deg.

Figure 19. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.

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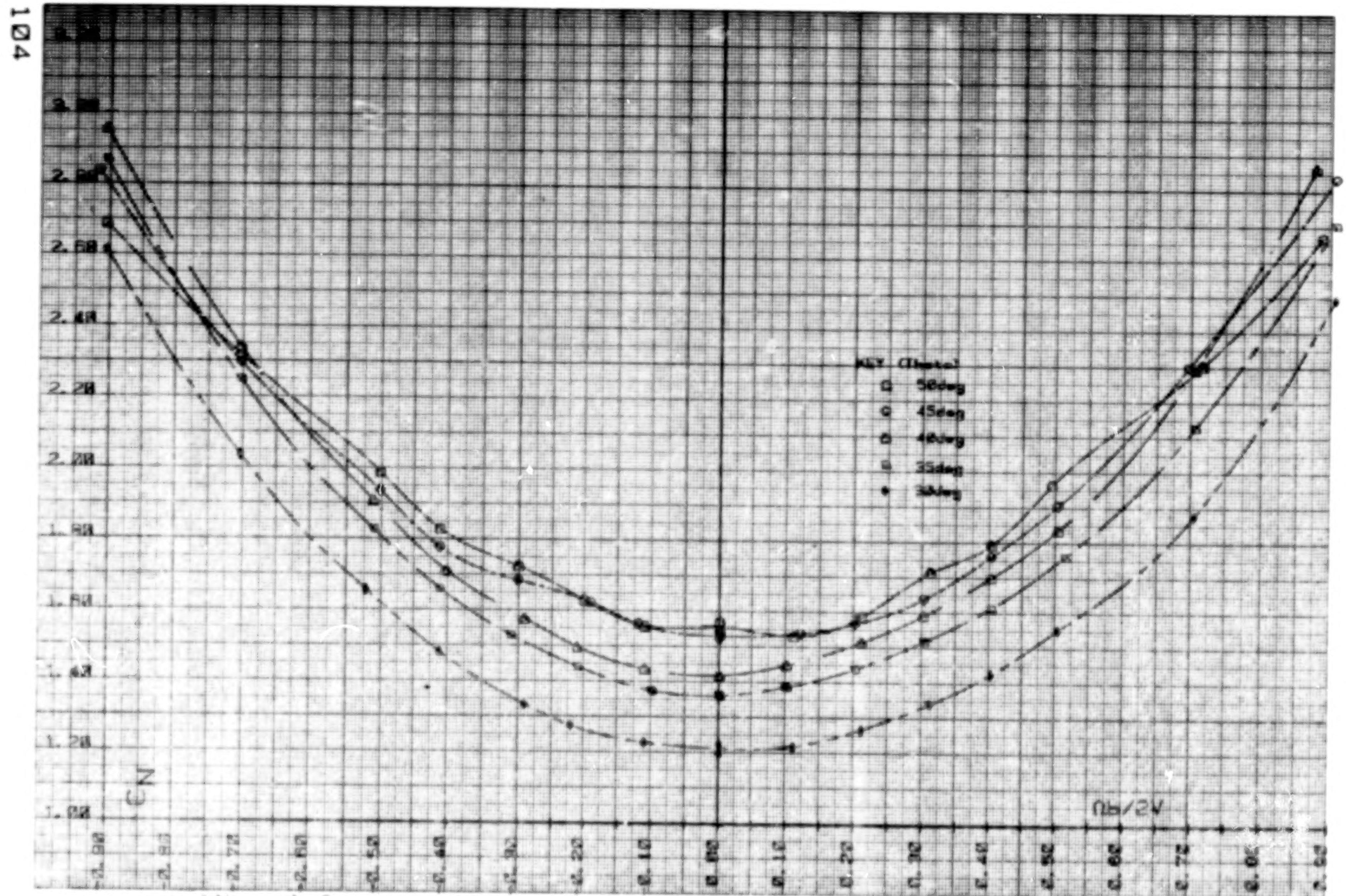
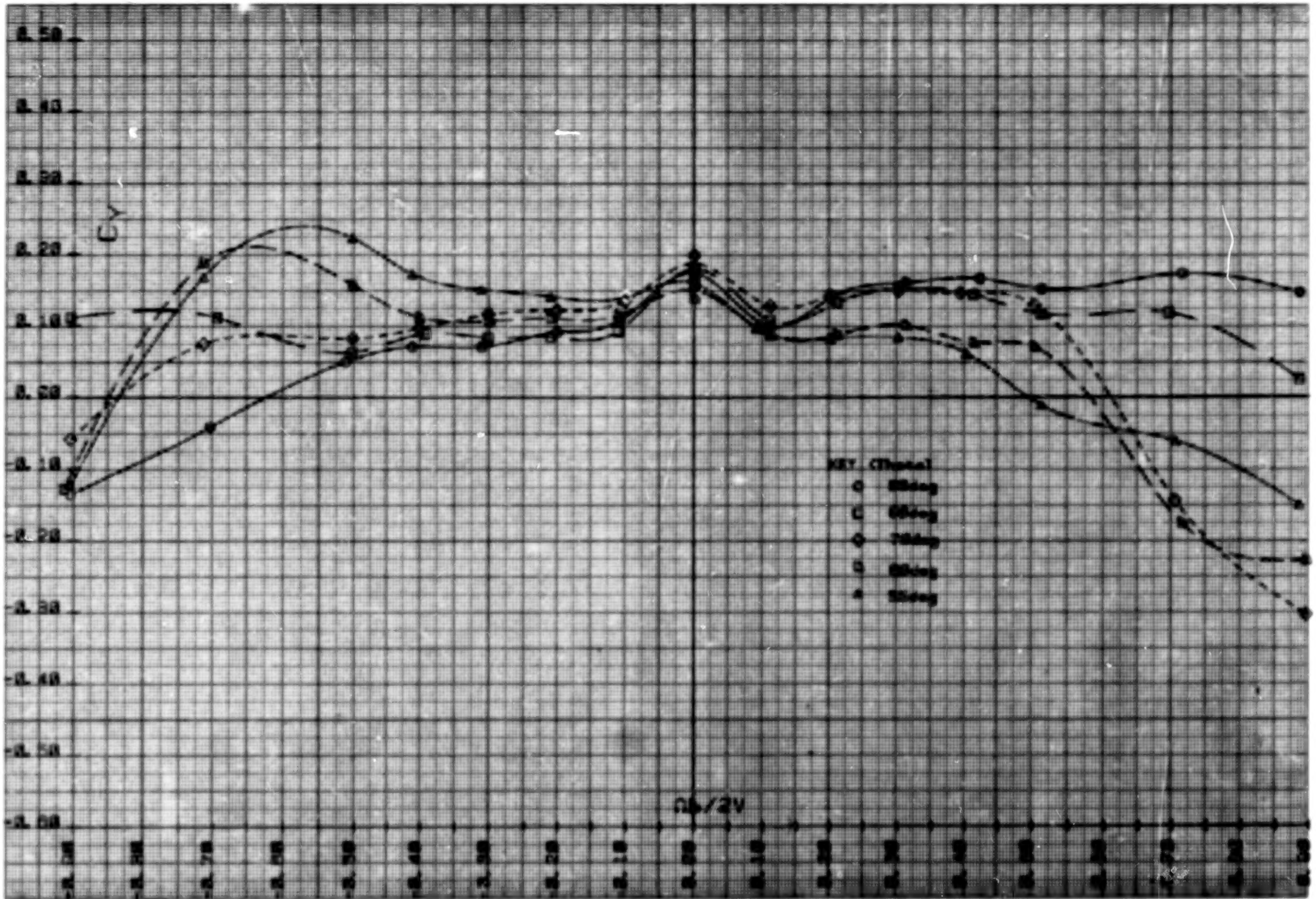


(c) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 19.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.



( ) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 19.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.

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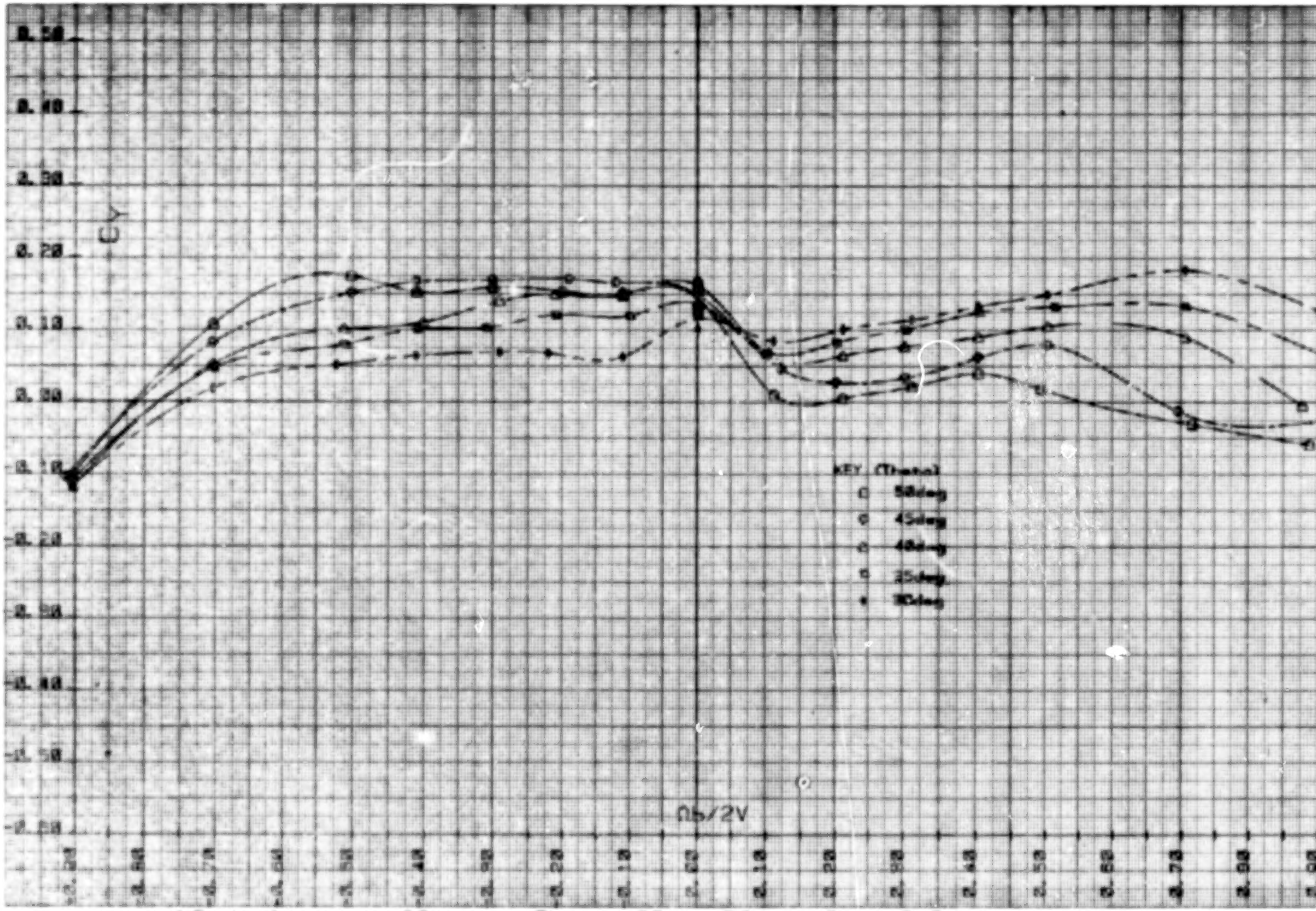
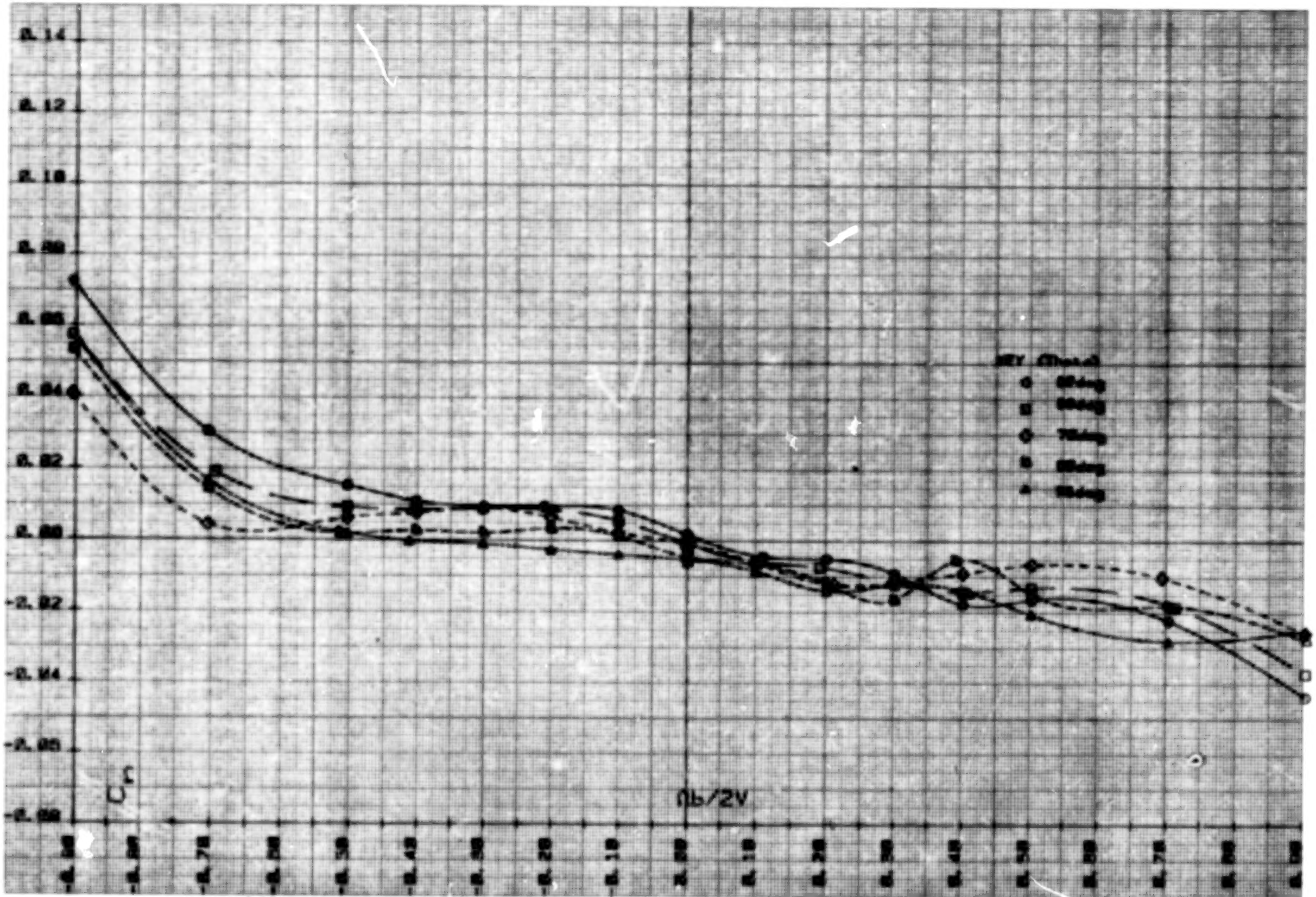


) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 19.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.



a.) Yawing-moment coefficient. Theta= 55 to 90deg; Phi= 10.8deg.

Figure 20.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.

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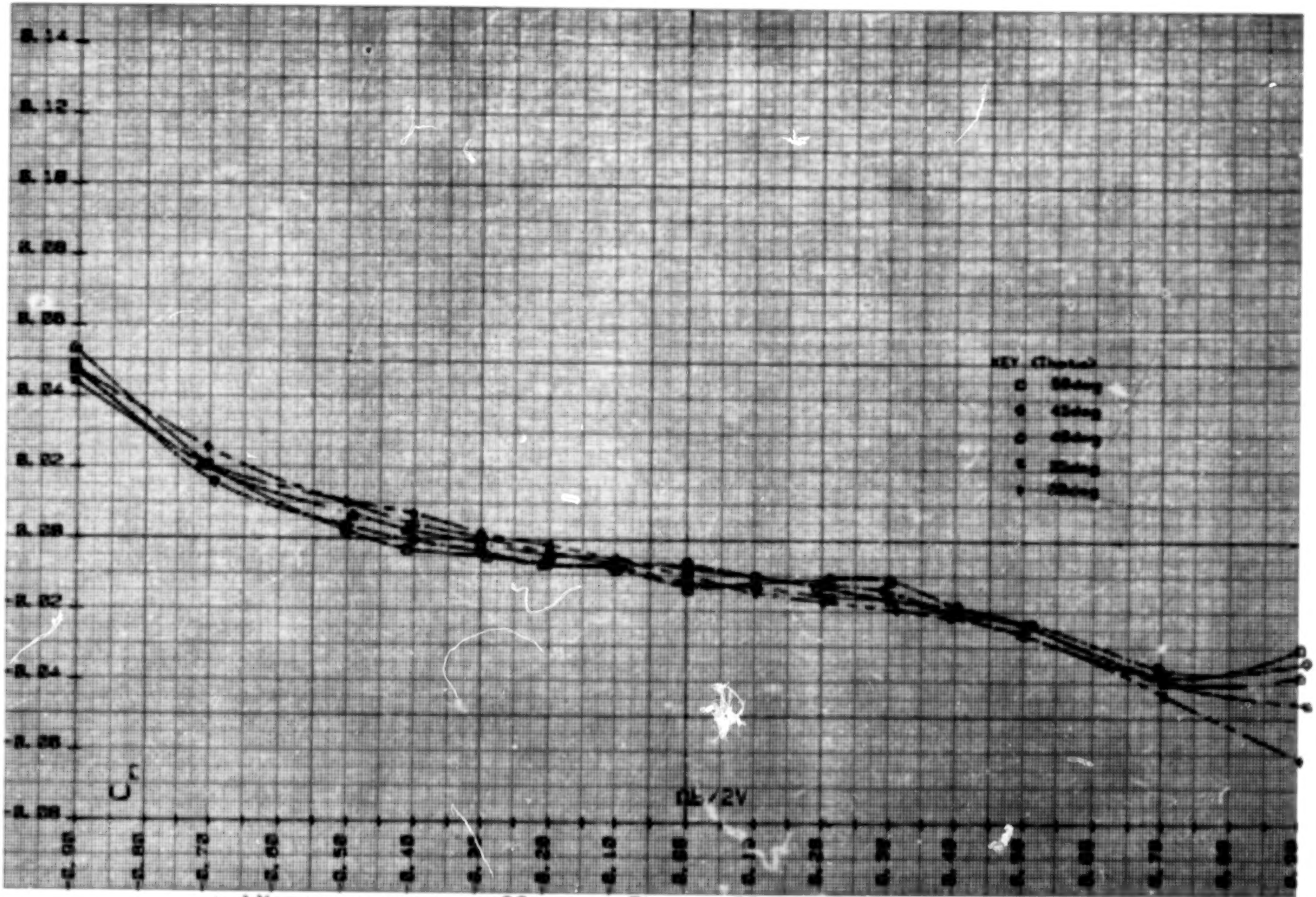
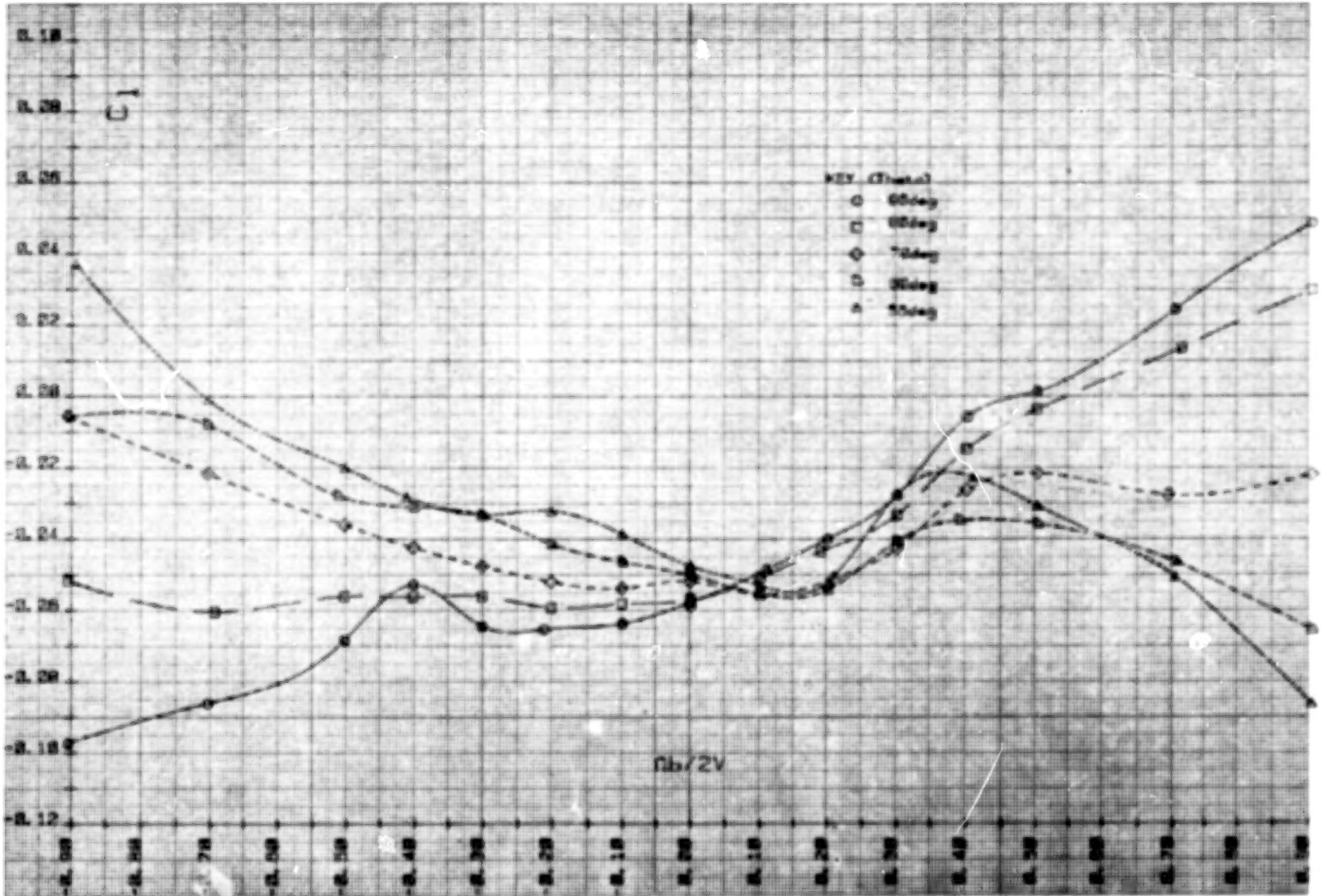


b.) Yawing-moment coefficient. Theta= 30 to 50deg; Phi= 10.7deg.

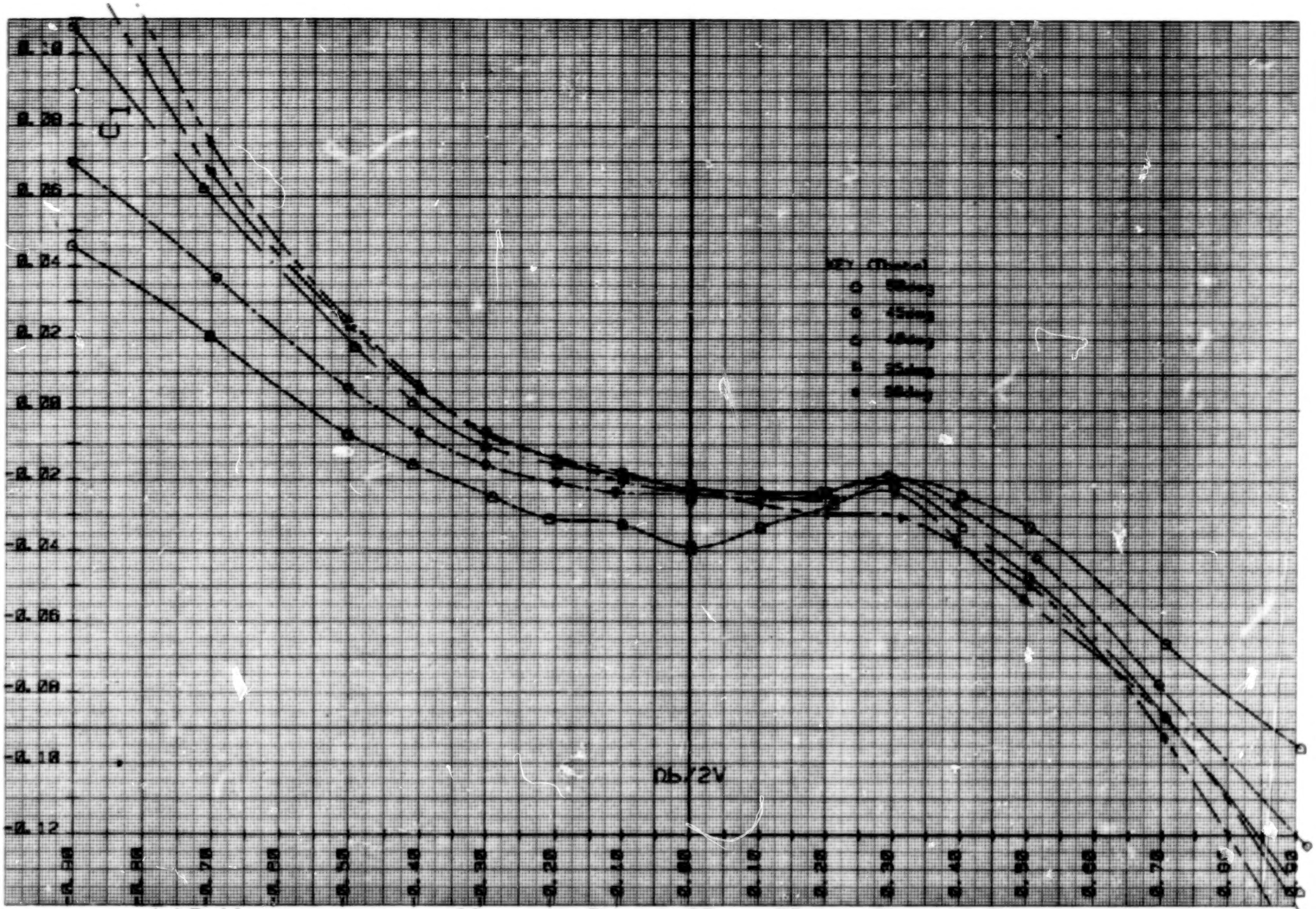
Figure 20.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.



a.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi= 10.8deg.

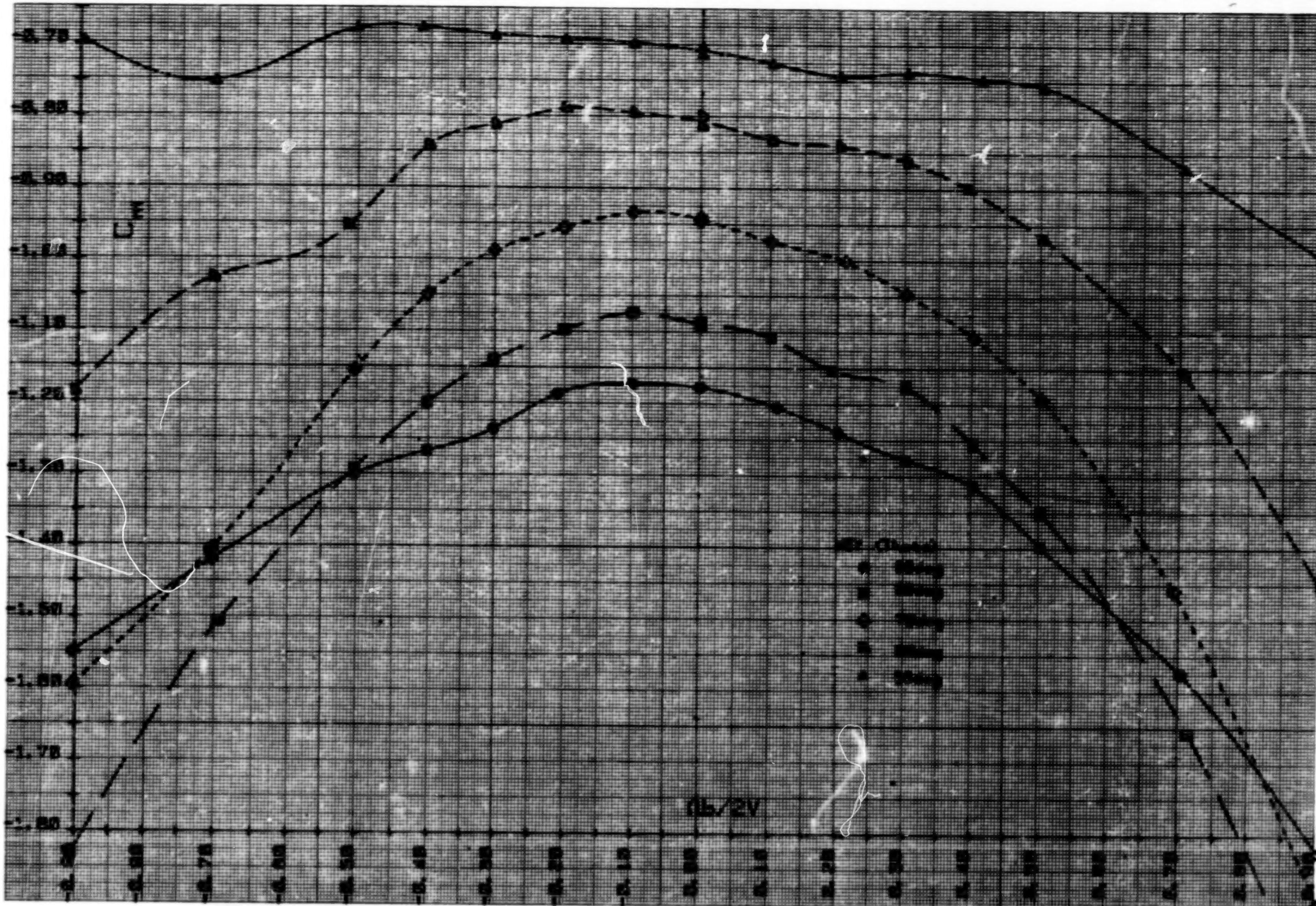
Figure 20. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.

109



(.)Rolling-moment coefficient, Theta= 30 to 50deg; Phi= 10.8deg.

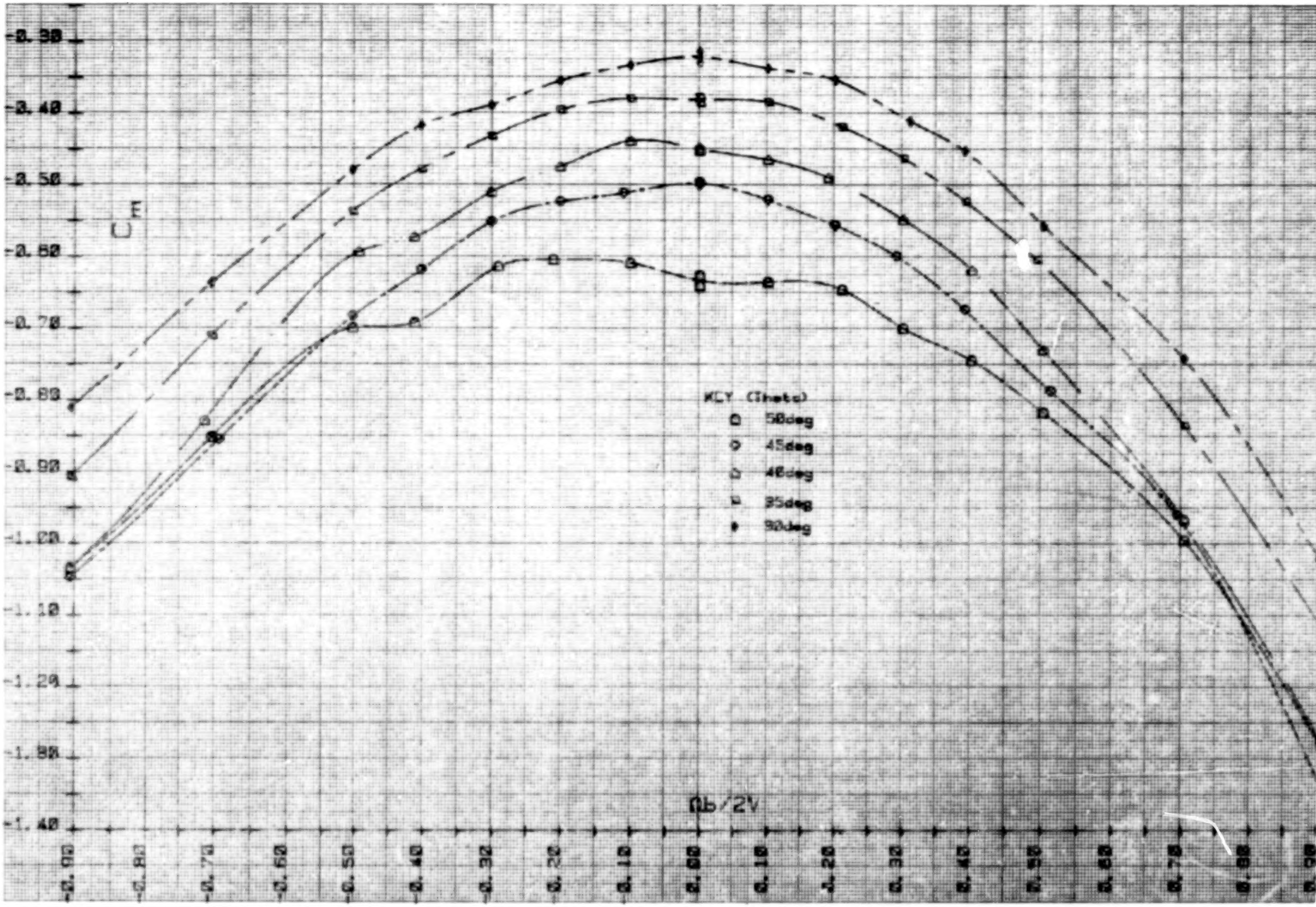
Figure 20.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.



e.)Pitching-moment coefficient. Theta= 55 to 90deg: Phi= 10.8deg.

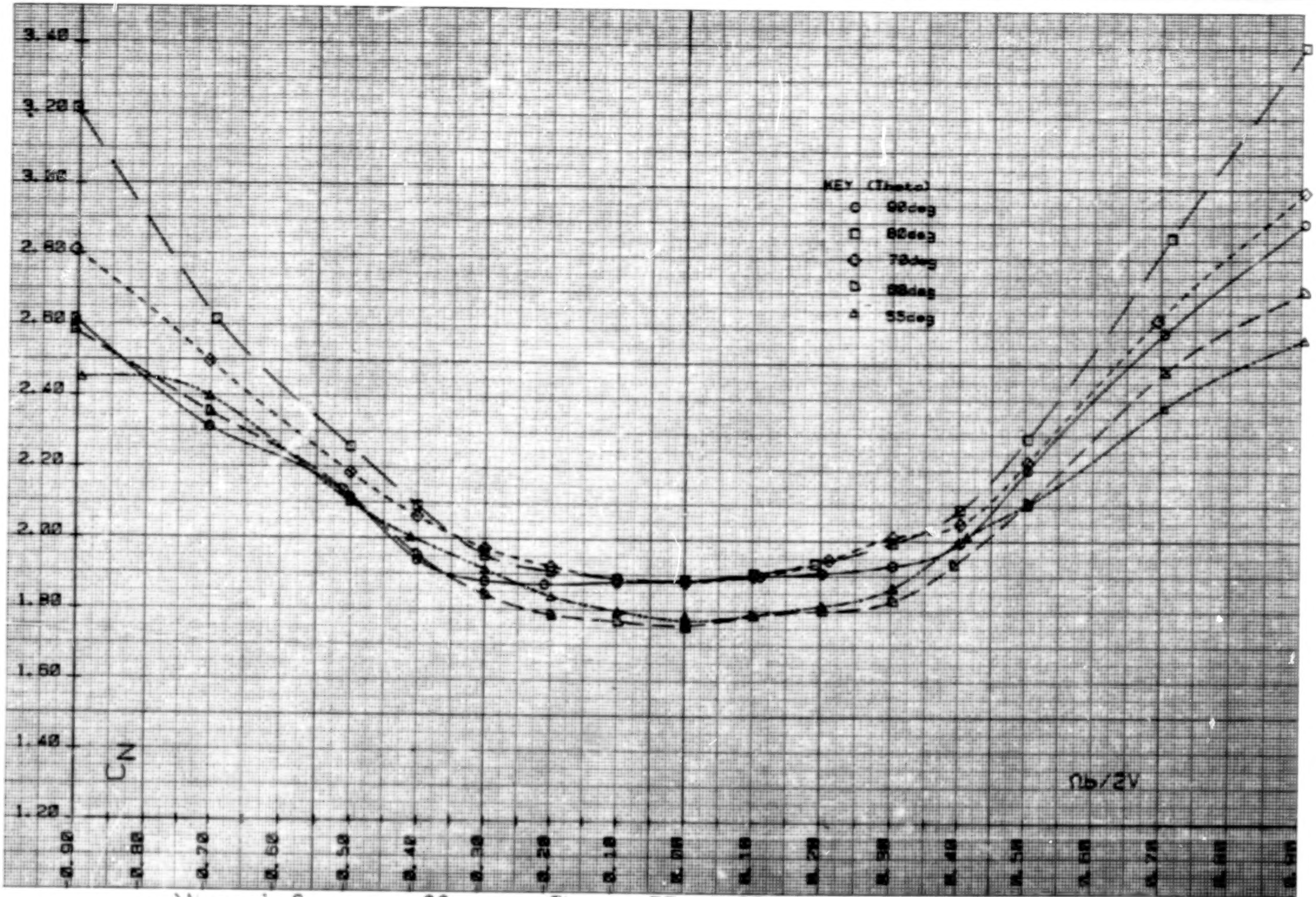
Figure 20.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.

111



(f) Pitching-moment coefficient, Theta= 30 to 50deg; Phi= 10.0deg.

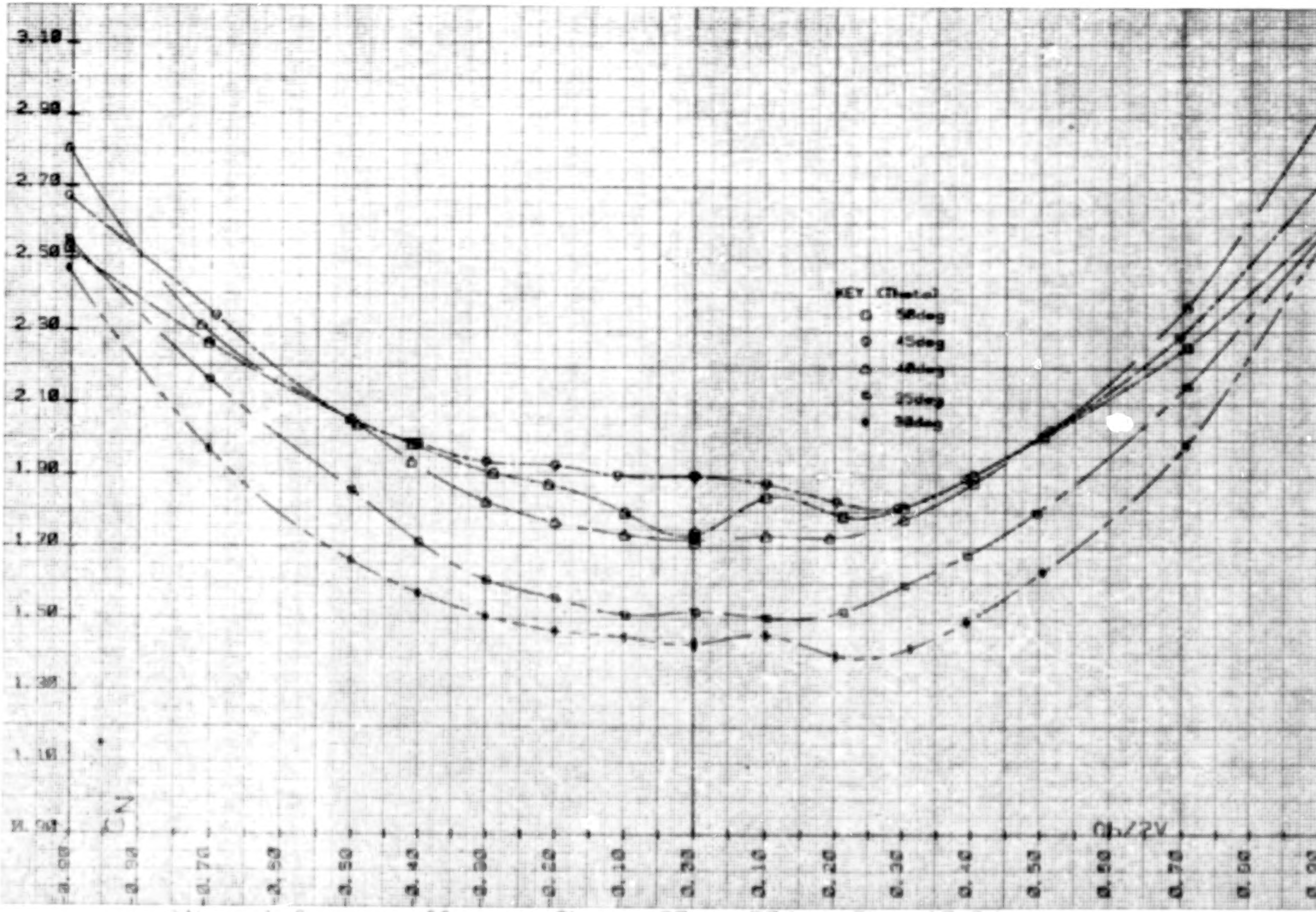
Figure 20.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.



g.) Normal-force coefficient. Theta= 55 to 90deg; Phi= 10.8deg.

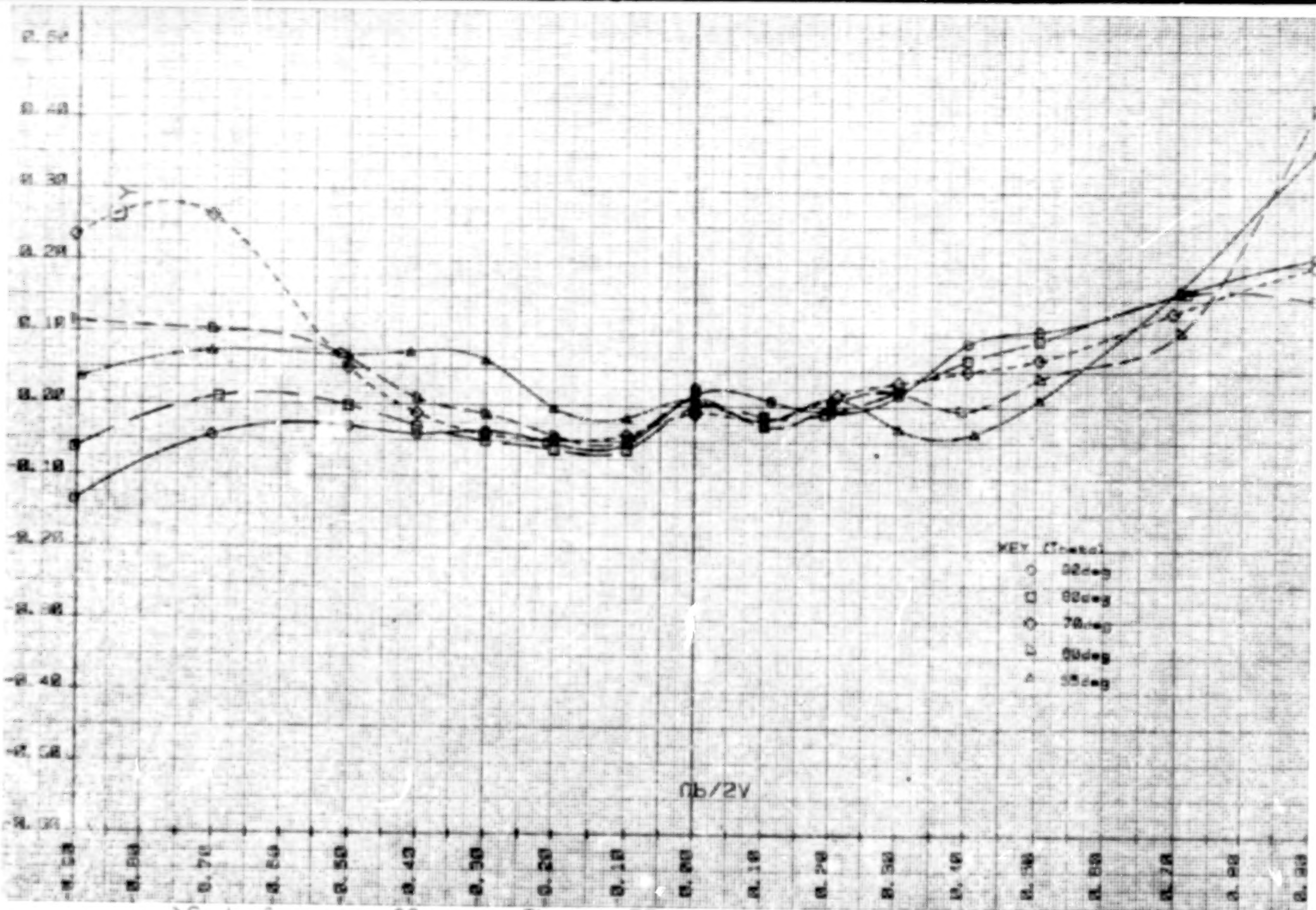
Figure 20.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.

113



(a.) Normal-force coefficient, Theta= 30 to 50deg; Phi= 10.8deg.

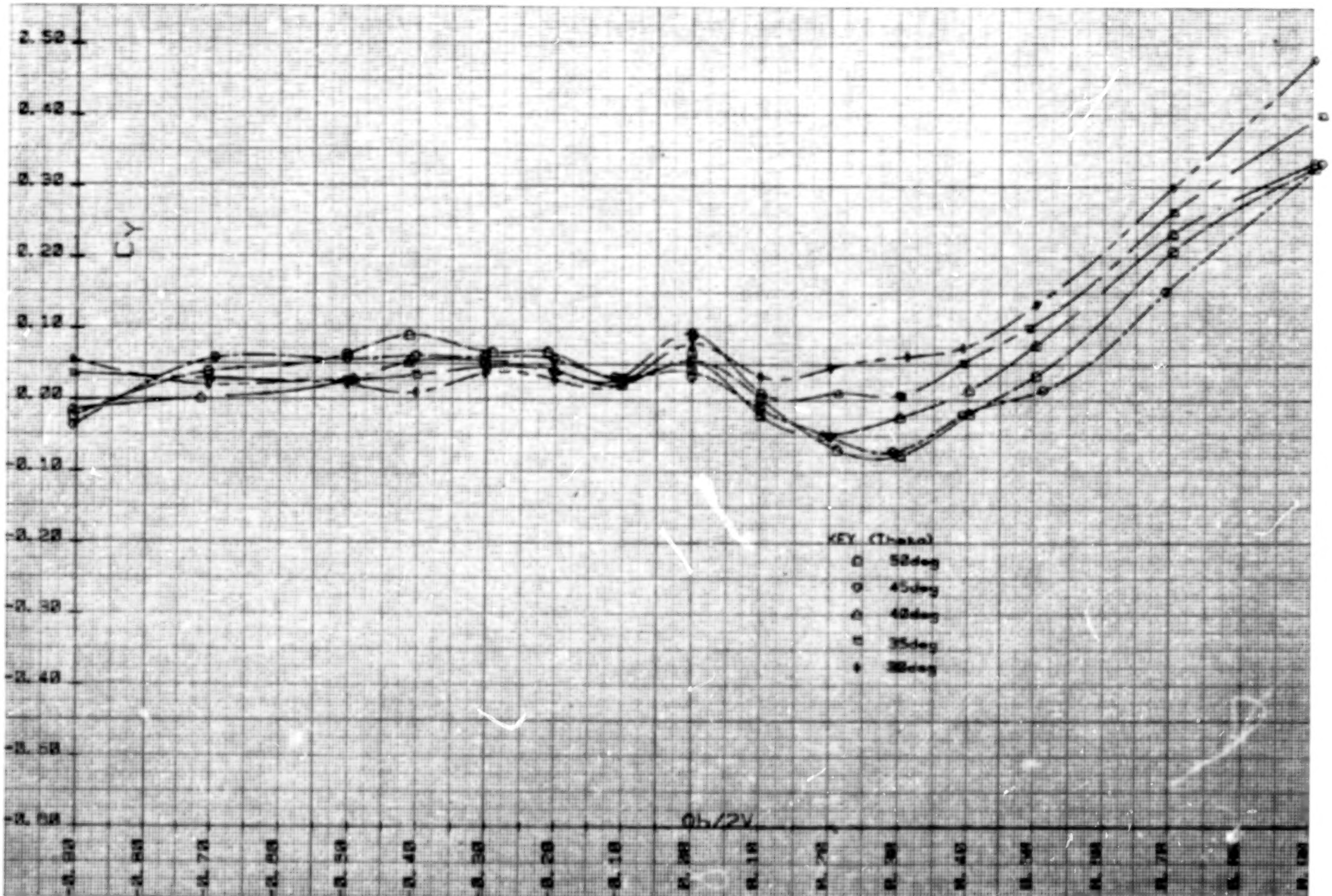
Figure 20. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.



(..) Side-force coefficient, Theta= 55 to 90deg; Phi= 10.8deg.

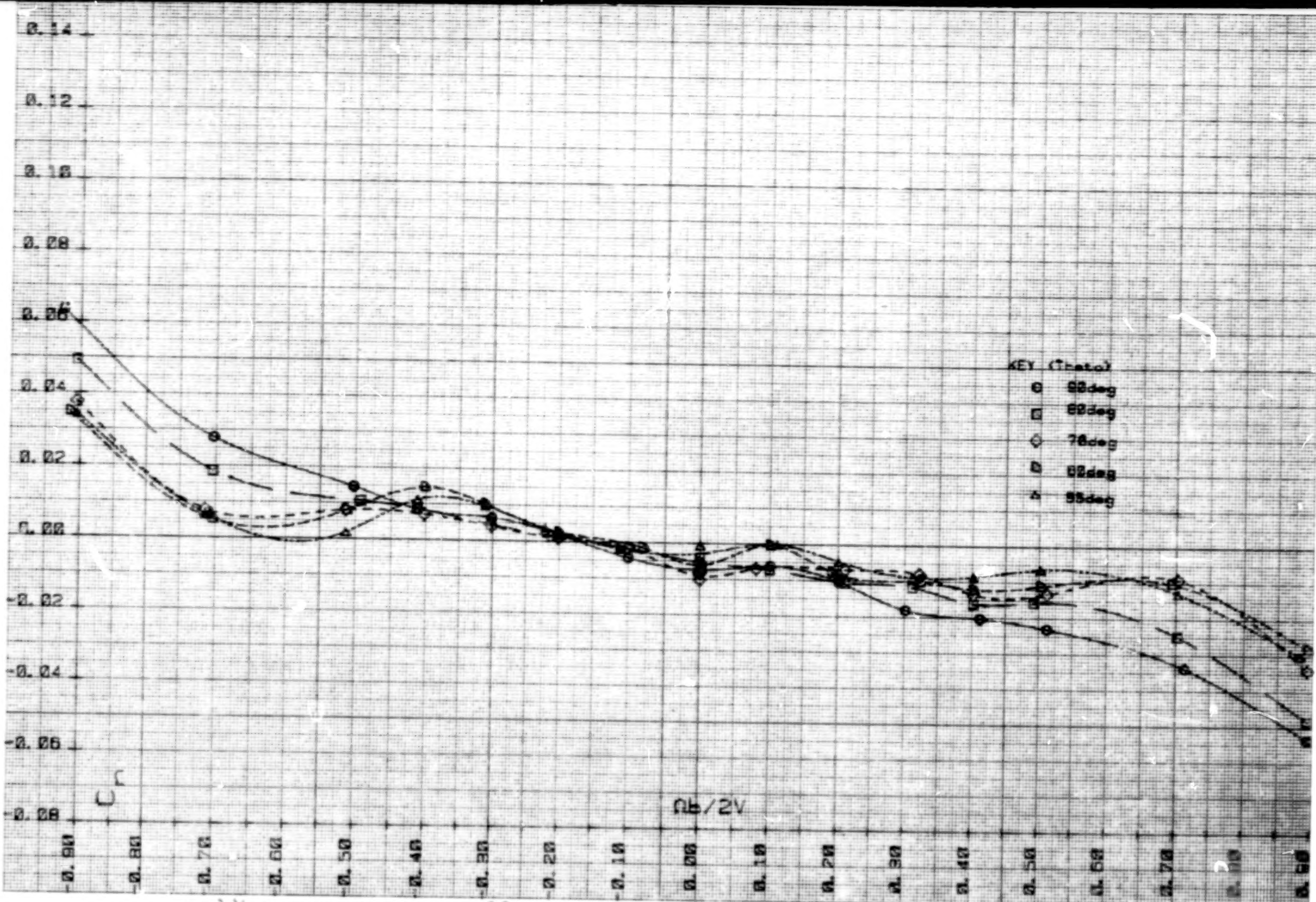
Figure 20.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.

116



(j.) Side-force coefficient, Theta= 30 to 50deg; Phi= 10.7deg.

Figure 20.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V.



a.) Yawing-moment coefficient. Theta= 55 to 90deg; Phi=-0.2deg.

Figure 21.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e.

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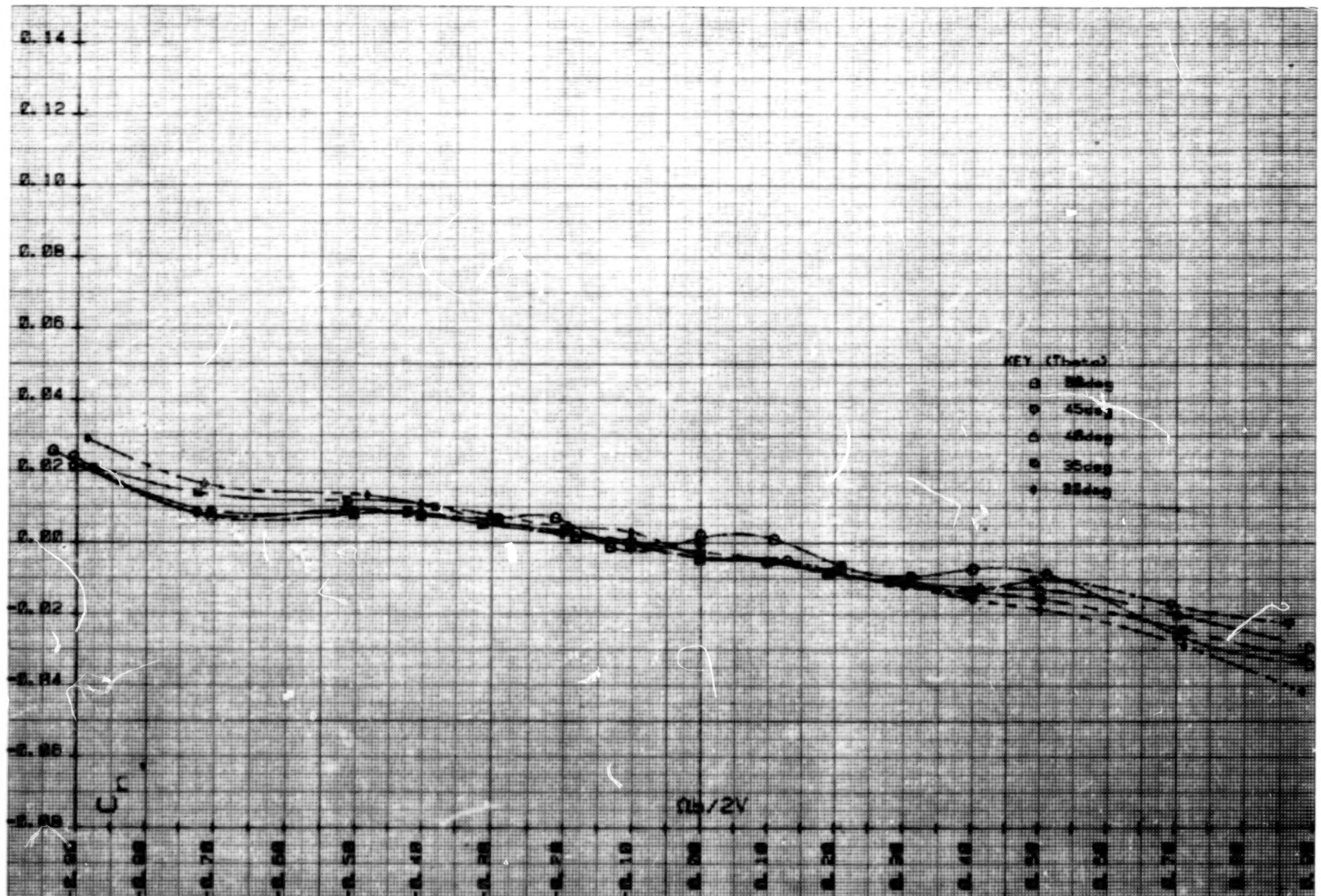
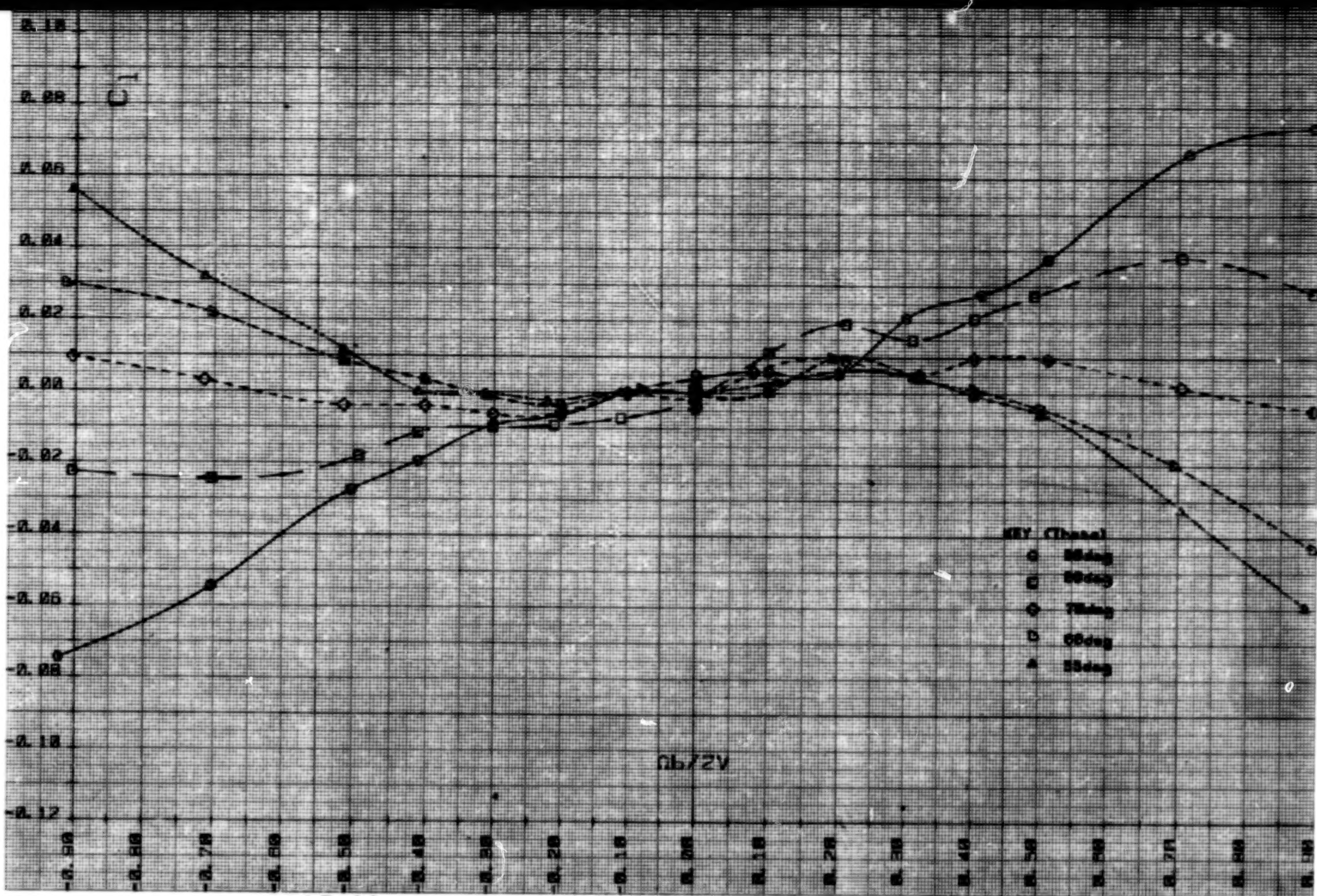


b.) Yawing-moment coefficient. Theta= 30 to 50deg; Phi=-0.3deg.

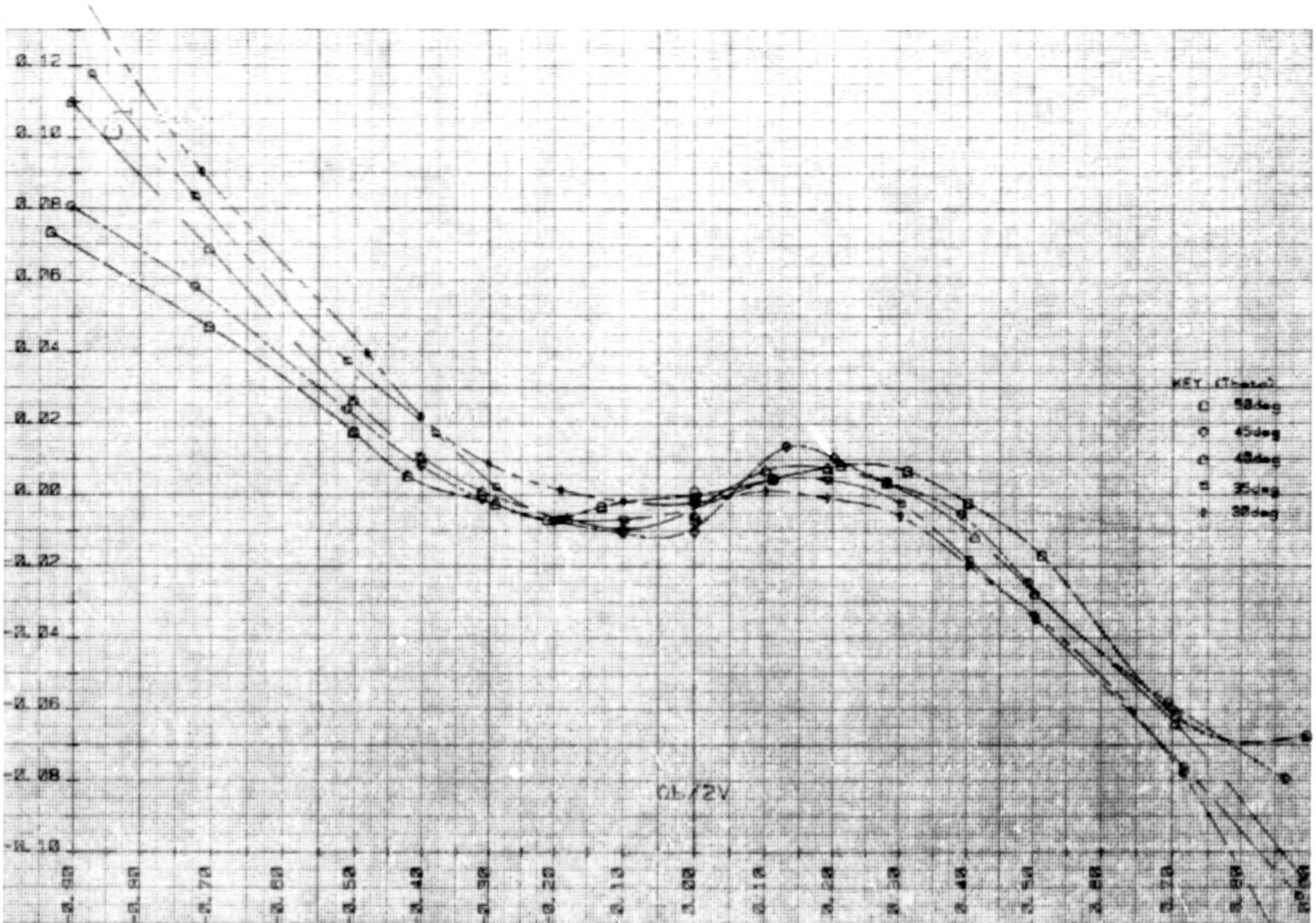
Figure 21.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e.



c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

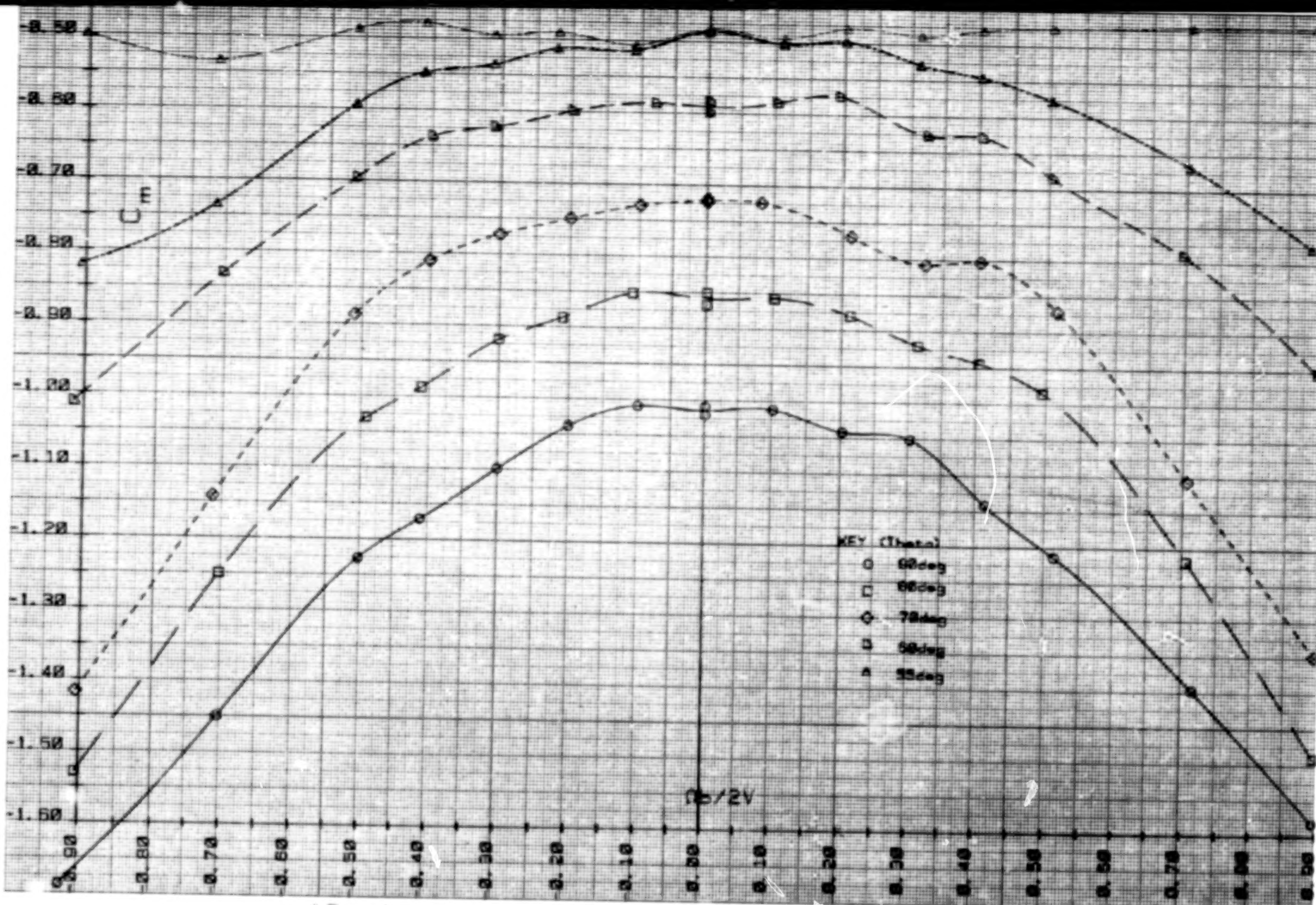
Figure 21.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e.

120



d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 21.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e.



a.) Pitching-moment coefficient. Theta= 55 to 90deg: Phi=-0.4deg.

Figure 21.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e.

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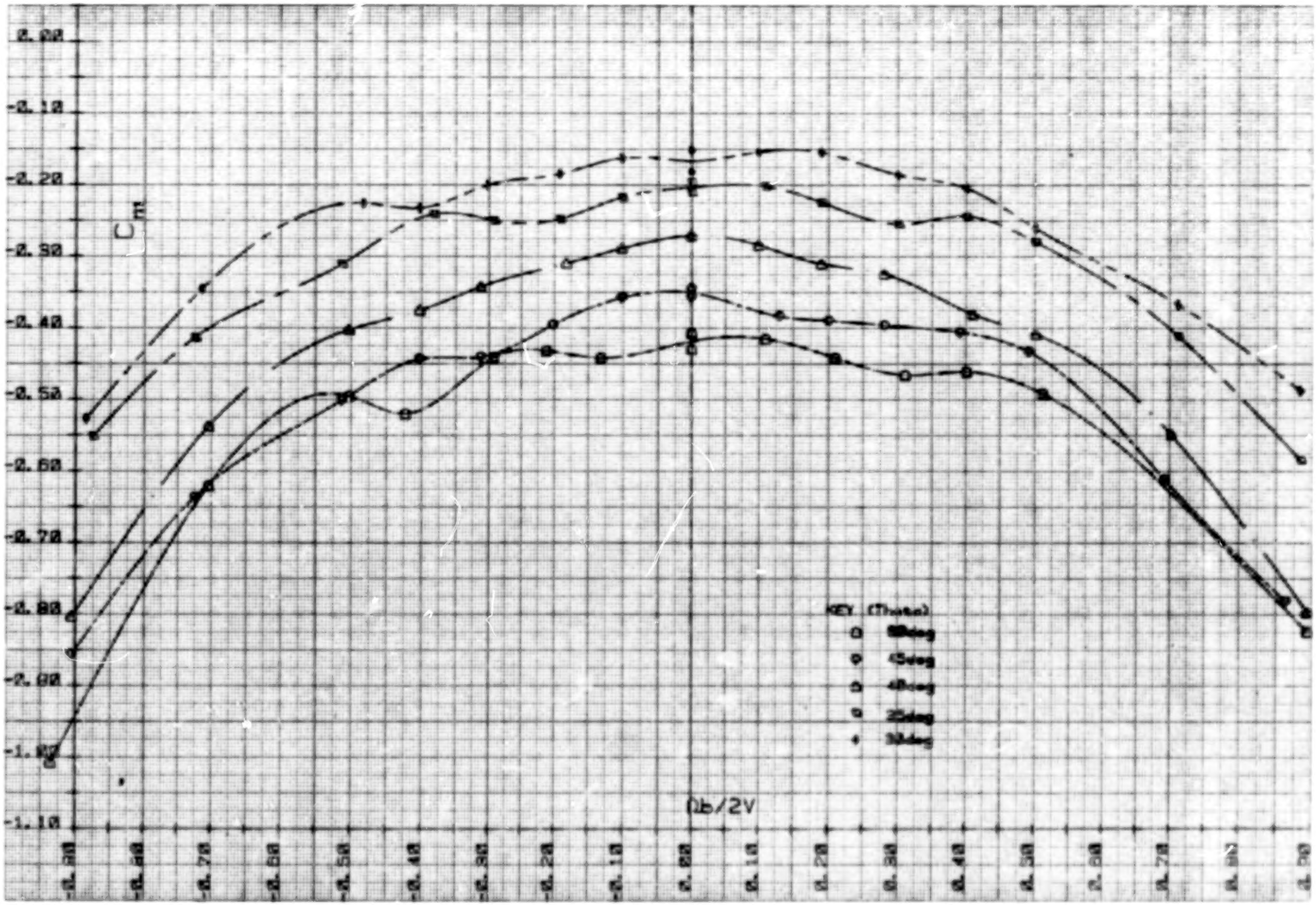
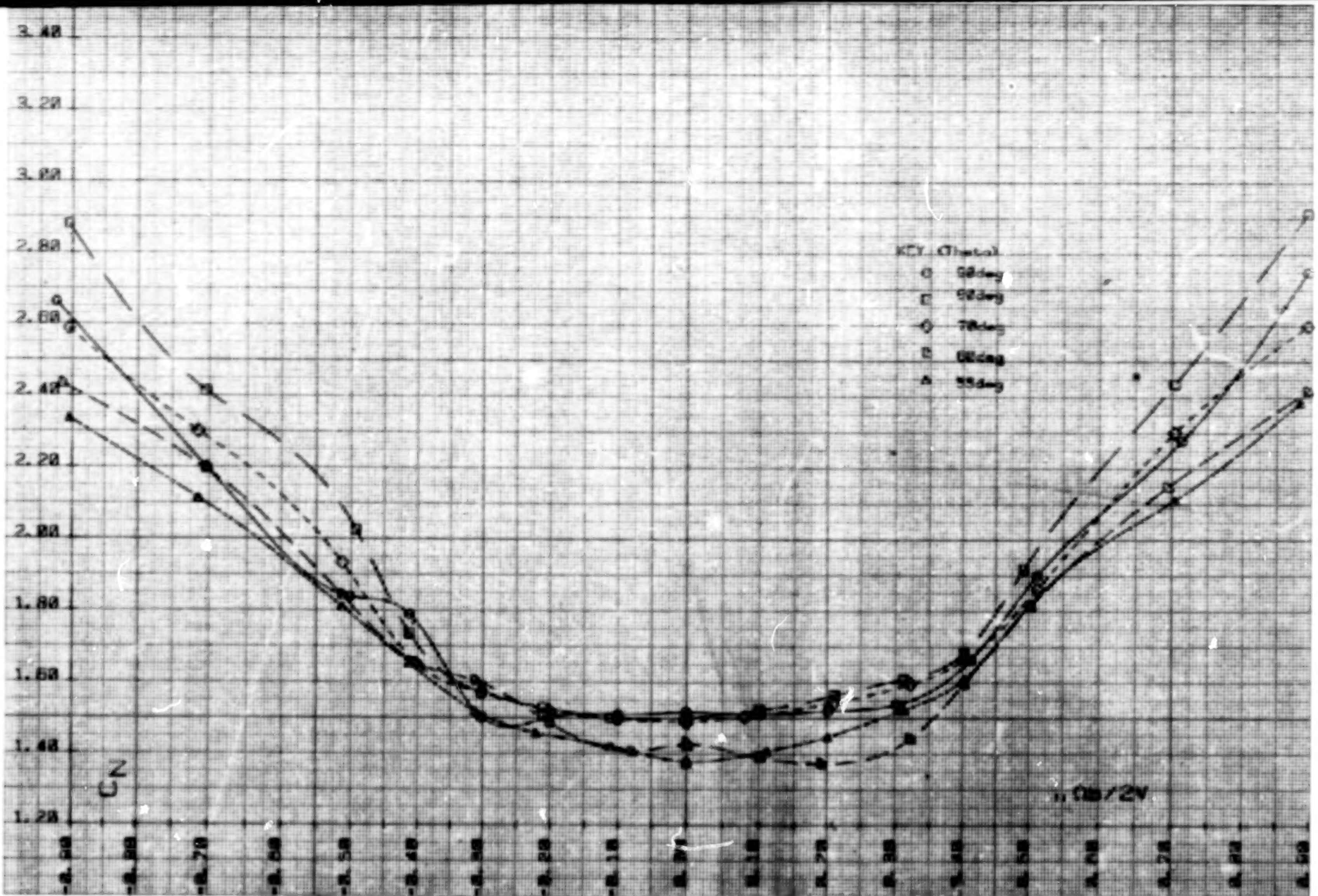


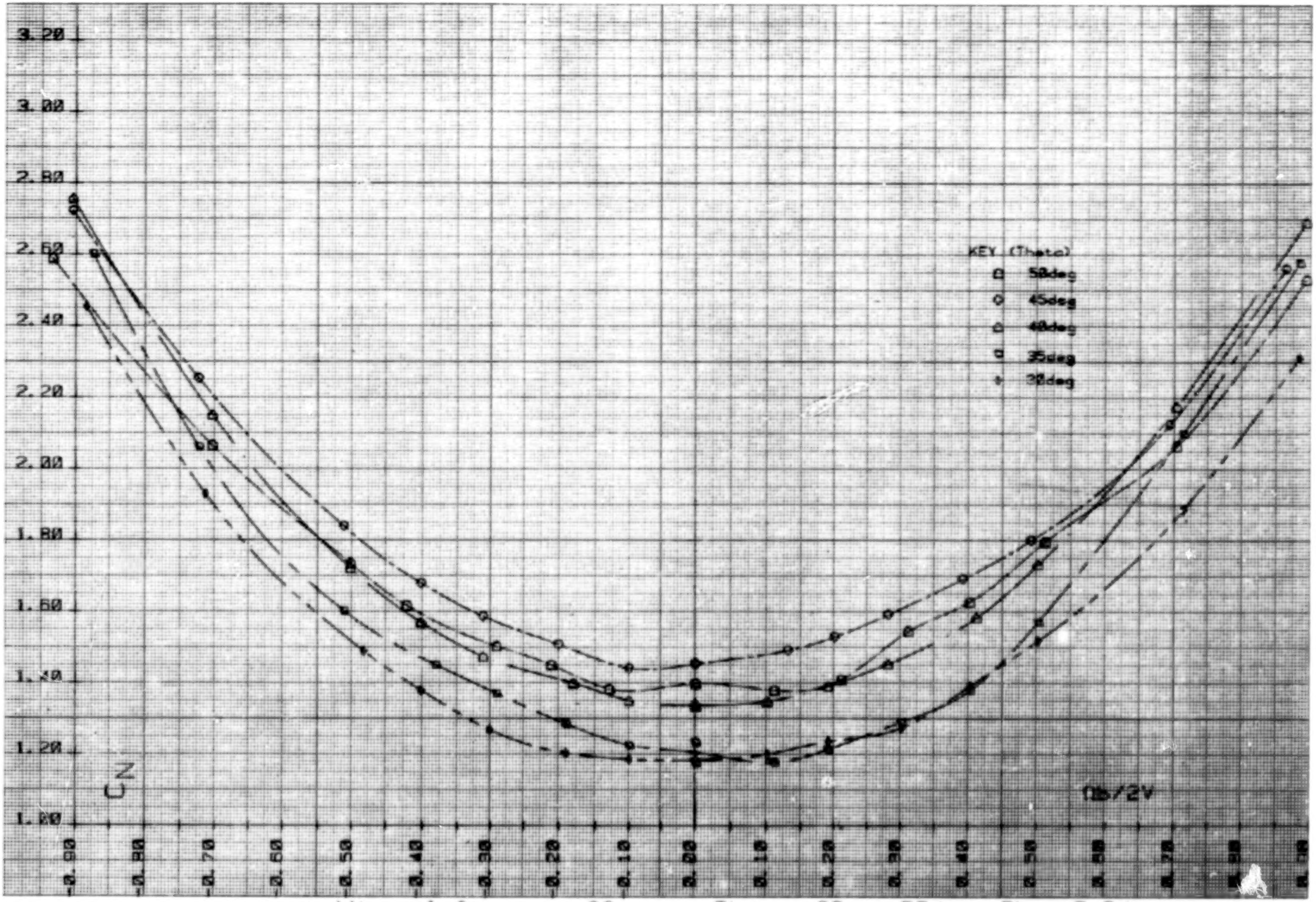
(f.)Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 21.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e.



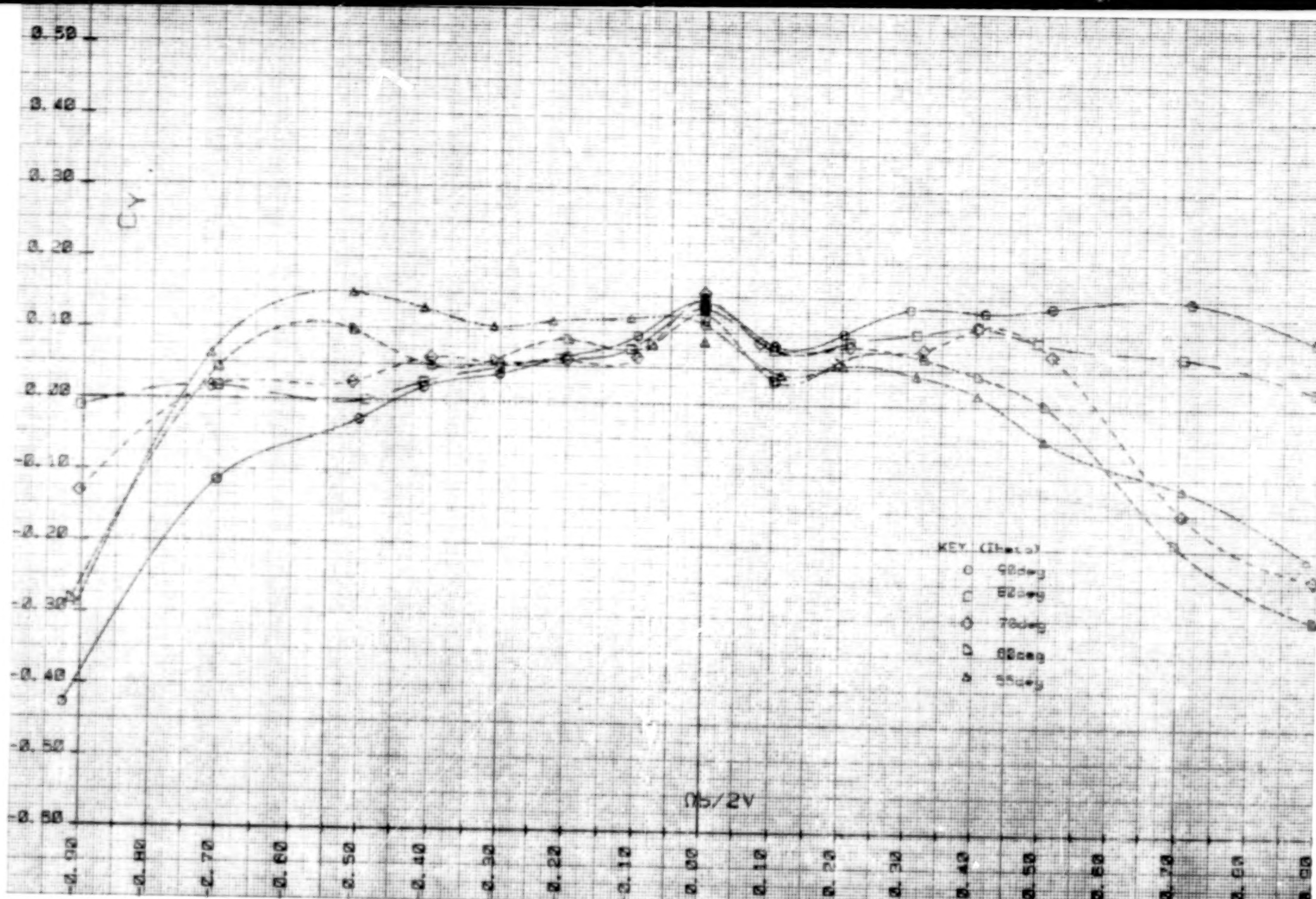
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 21. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e.



h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 21.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e.



a.) Side-force coefficient. Theta= 55 to 90deg; Phi=-0.2deg.

Figure 21.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e.

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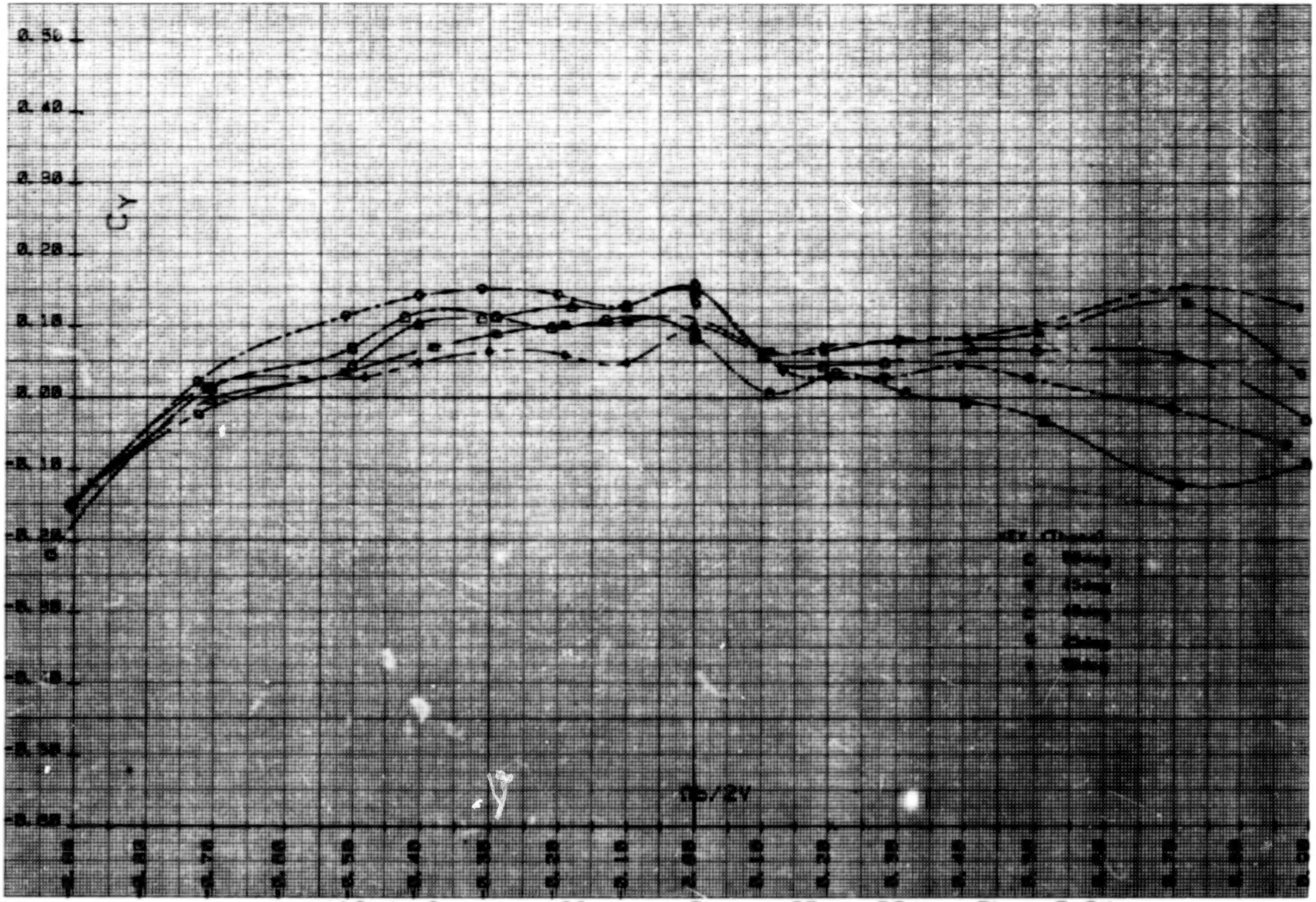
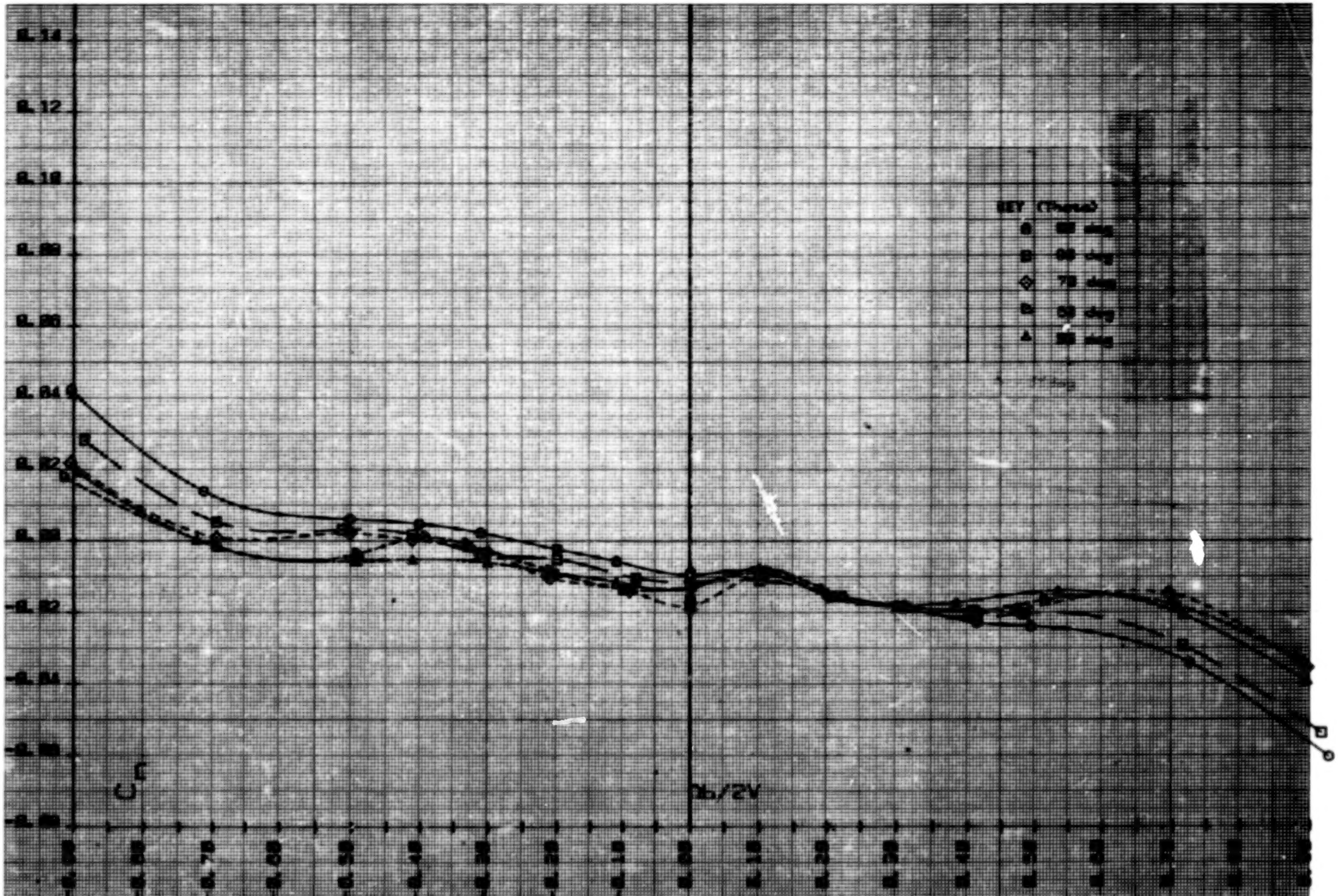


j.) Side-force coefficient, Theta= 30 to 50deg: Phi=-0.2deg.

Figure 21.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.6deg.

Figure 22.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+25r-25e.

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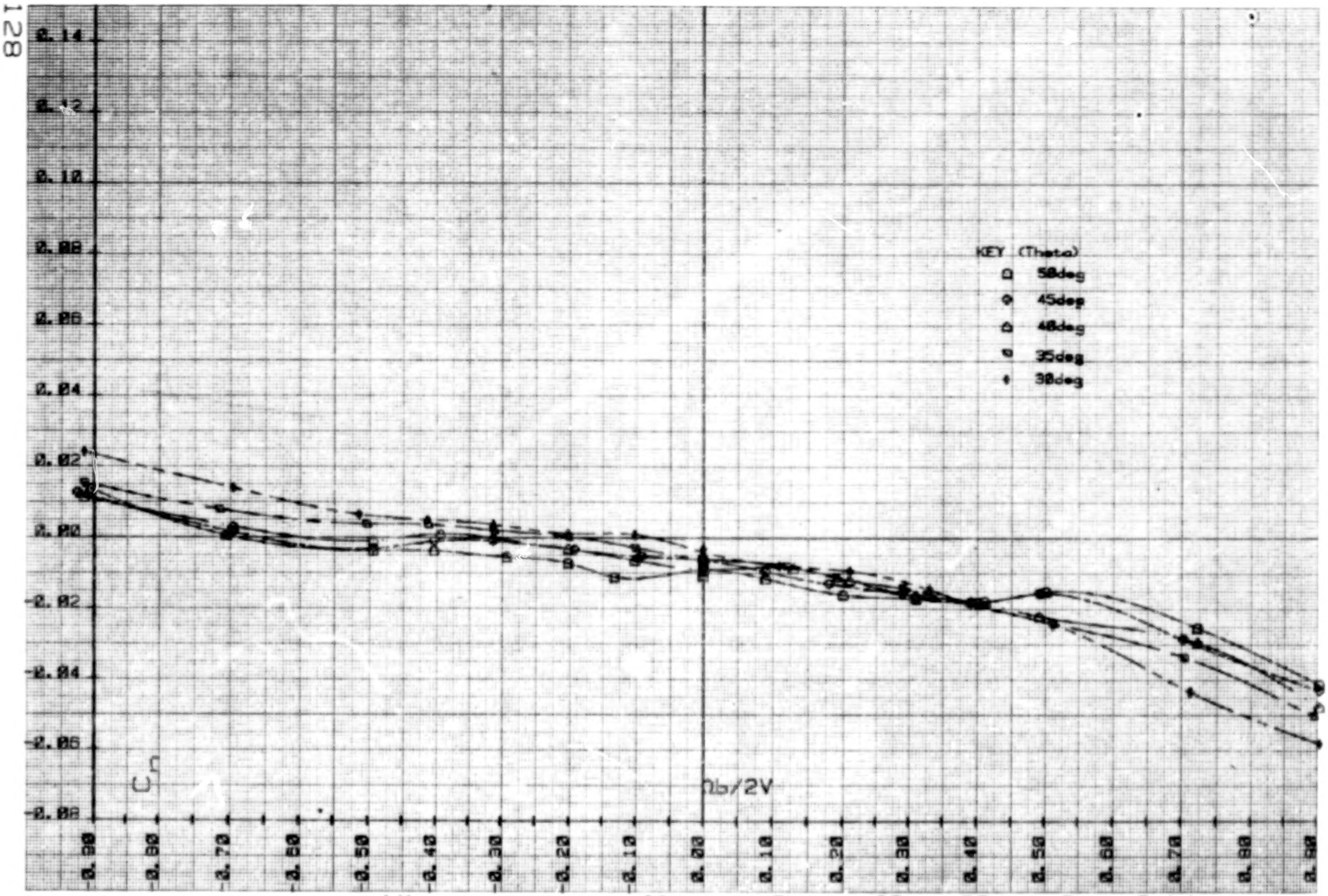
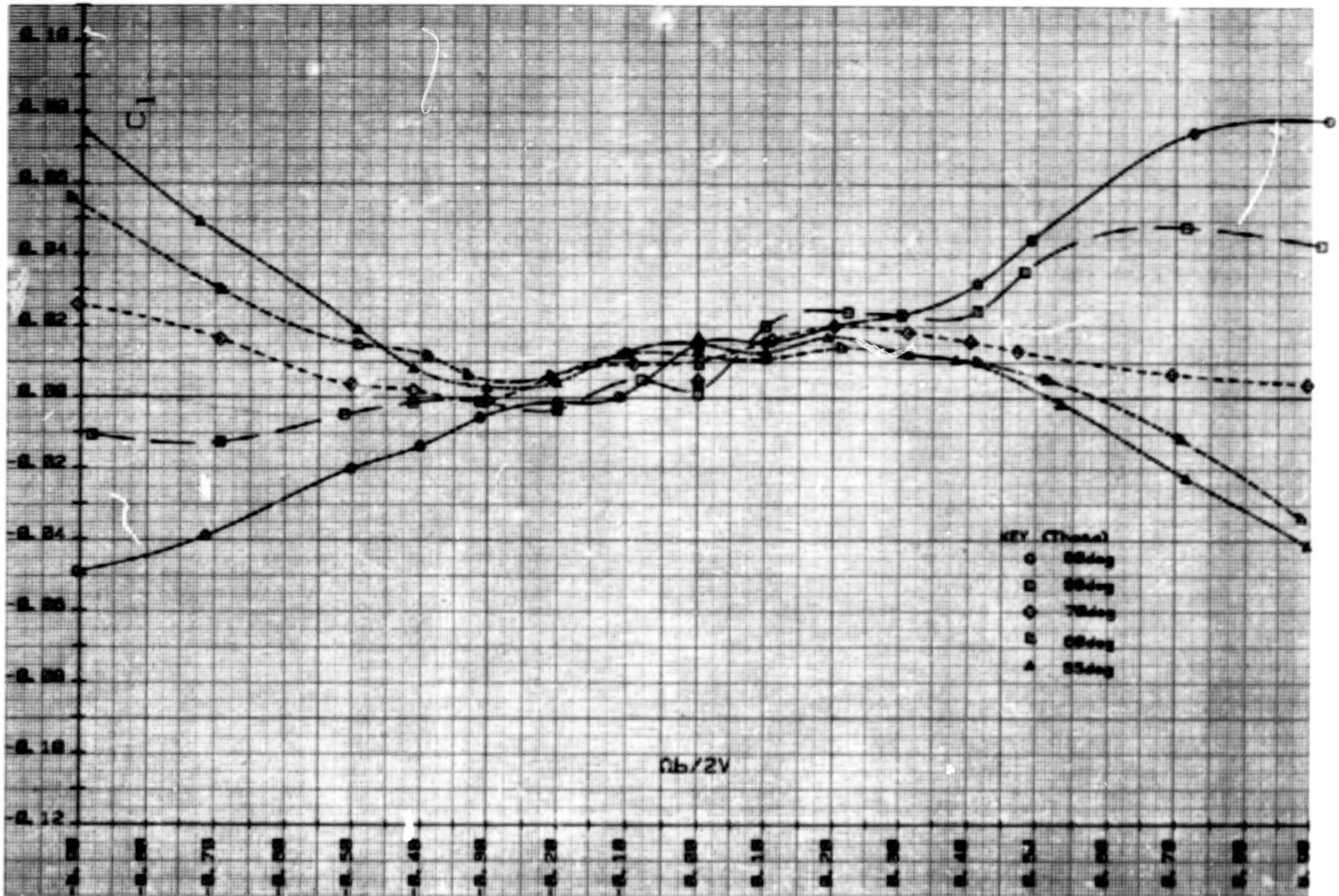


b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

Figure 22.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+25r-25e.



c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.6deg.

Figure 22.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+25r-25e.

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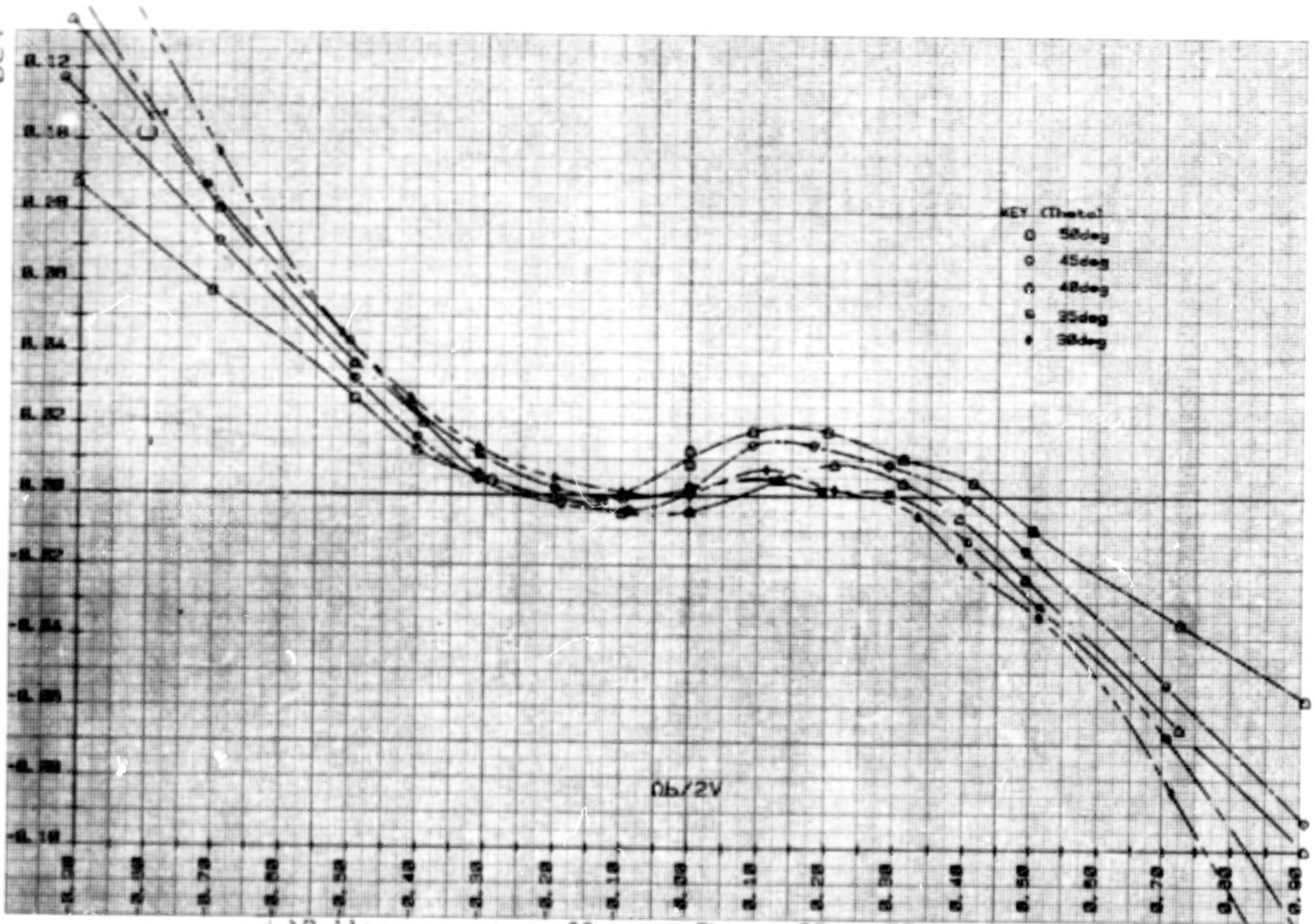
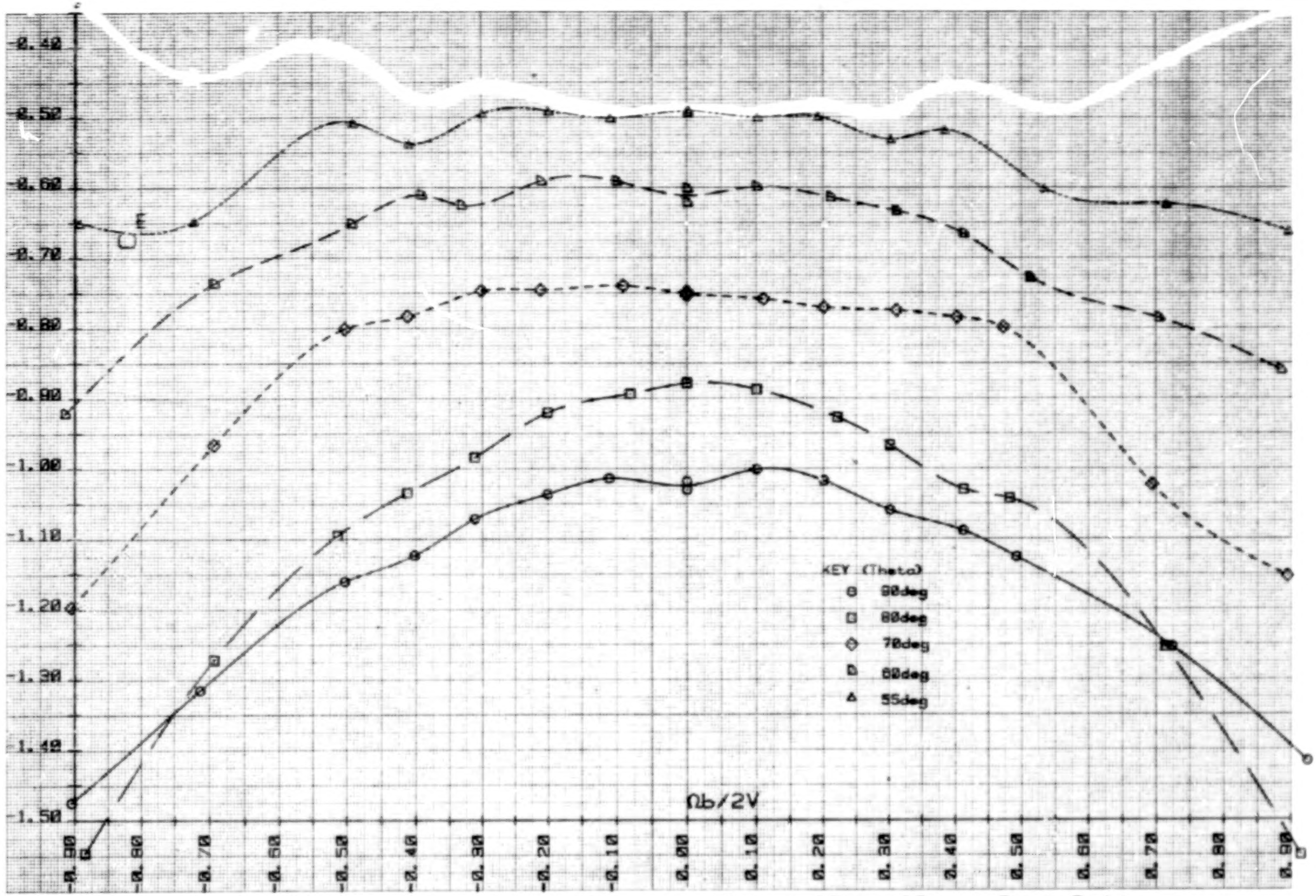


d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

Figure 22.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+25r-25e.



e.) Pitching-moment coefficient. Theta= 55 to 90deg; Phi=-0.4deg.

Figure 22. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+25r-25e.

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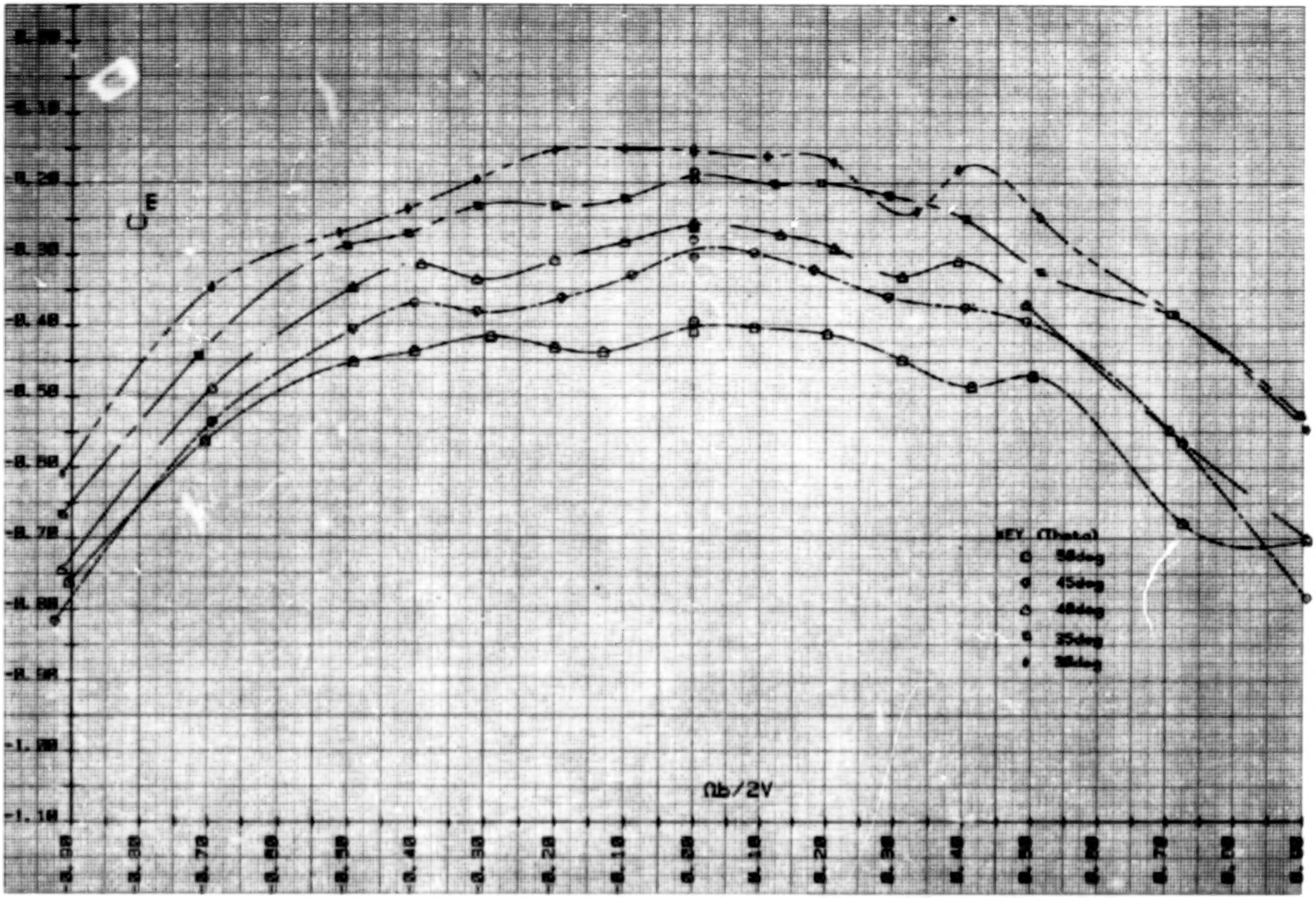
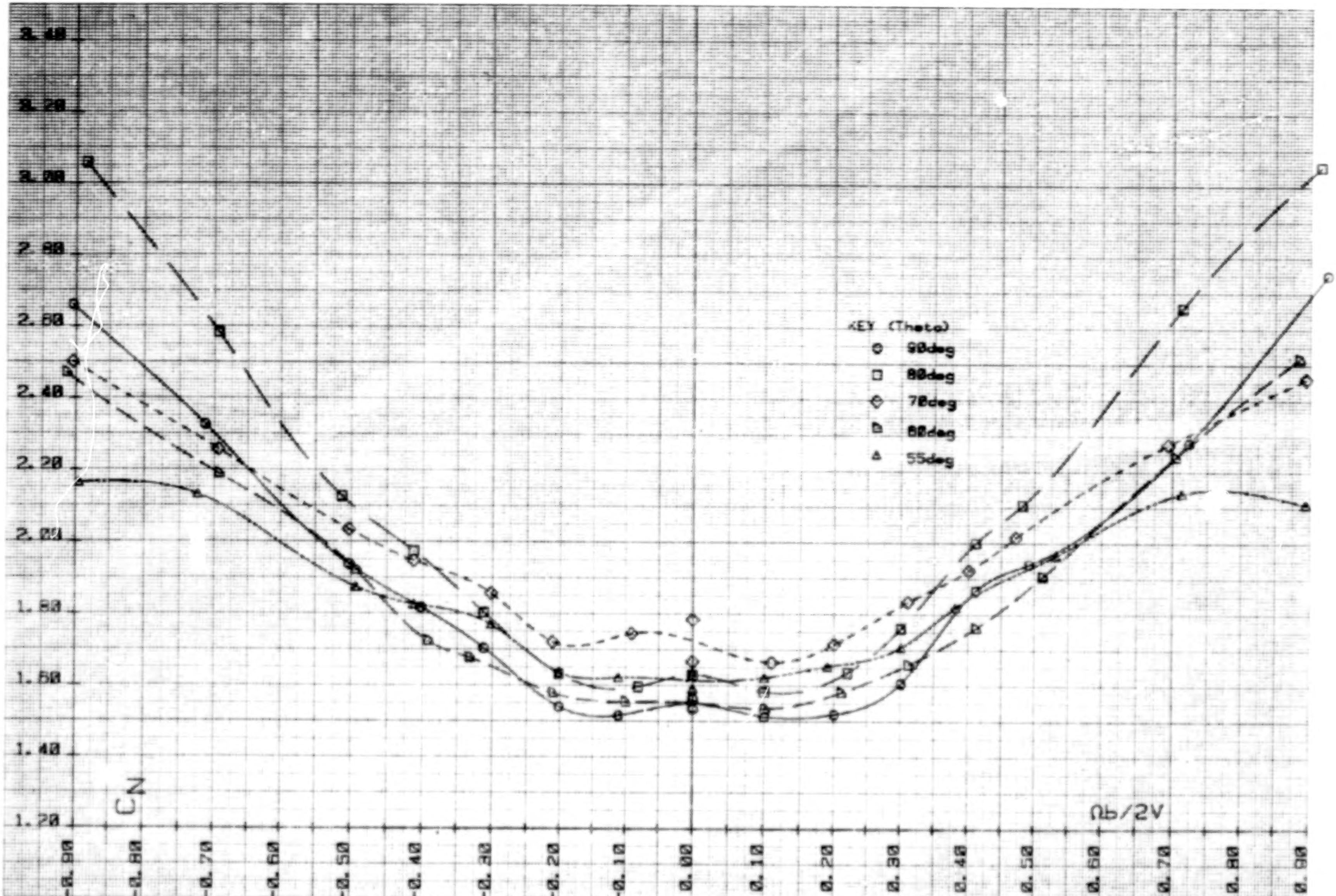


f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.6deg.

Figure 22.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+25r-25e.



a.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 22.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+25r-25e.

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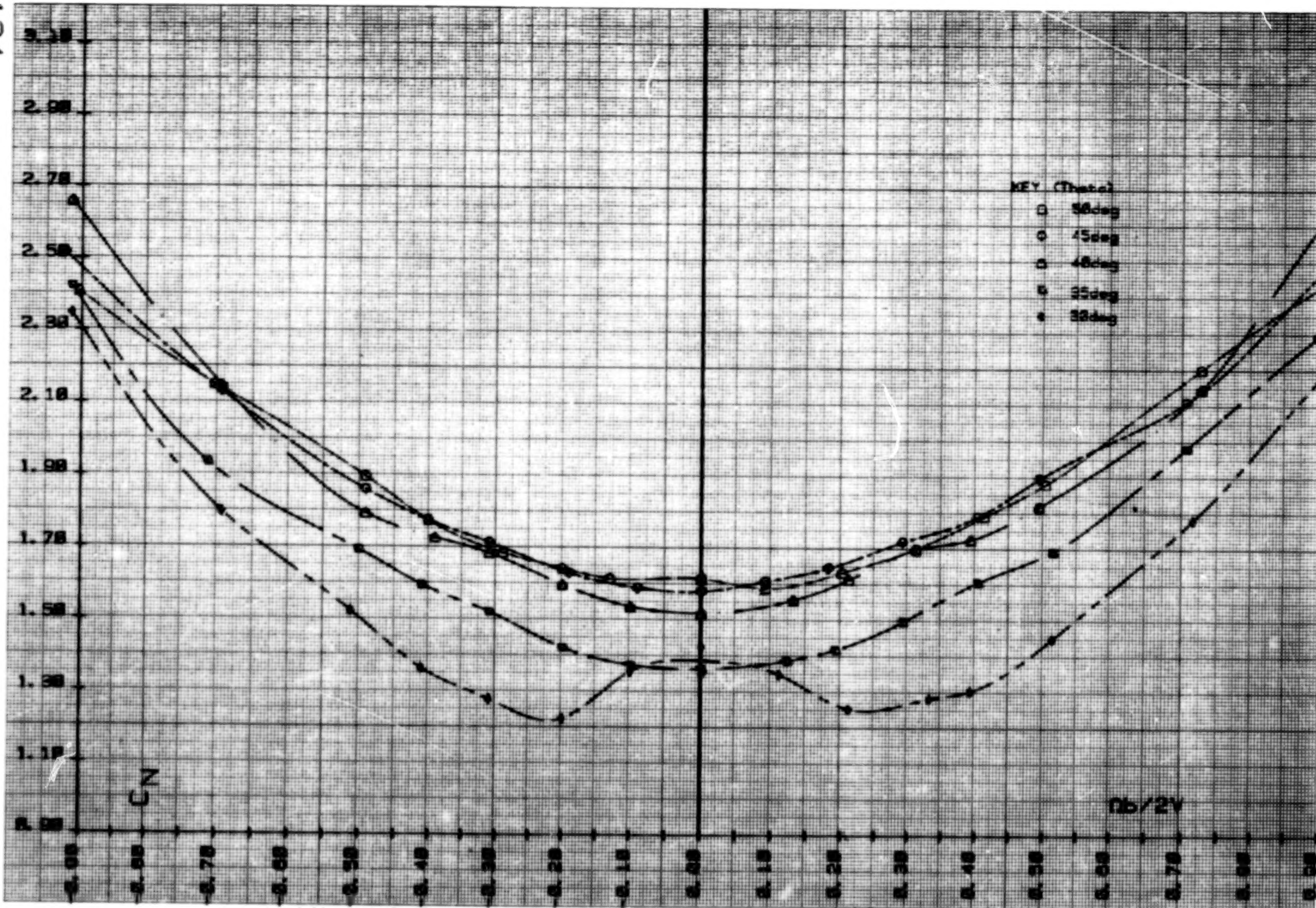
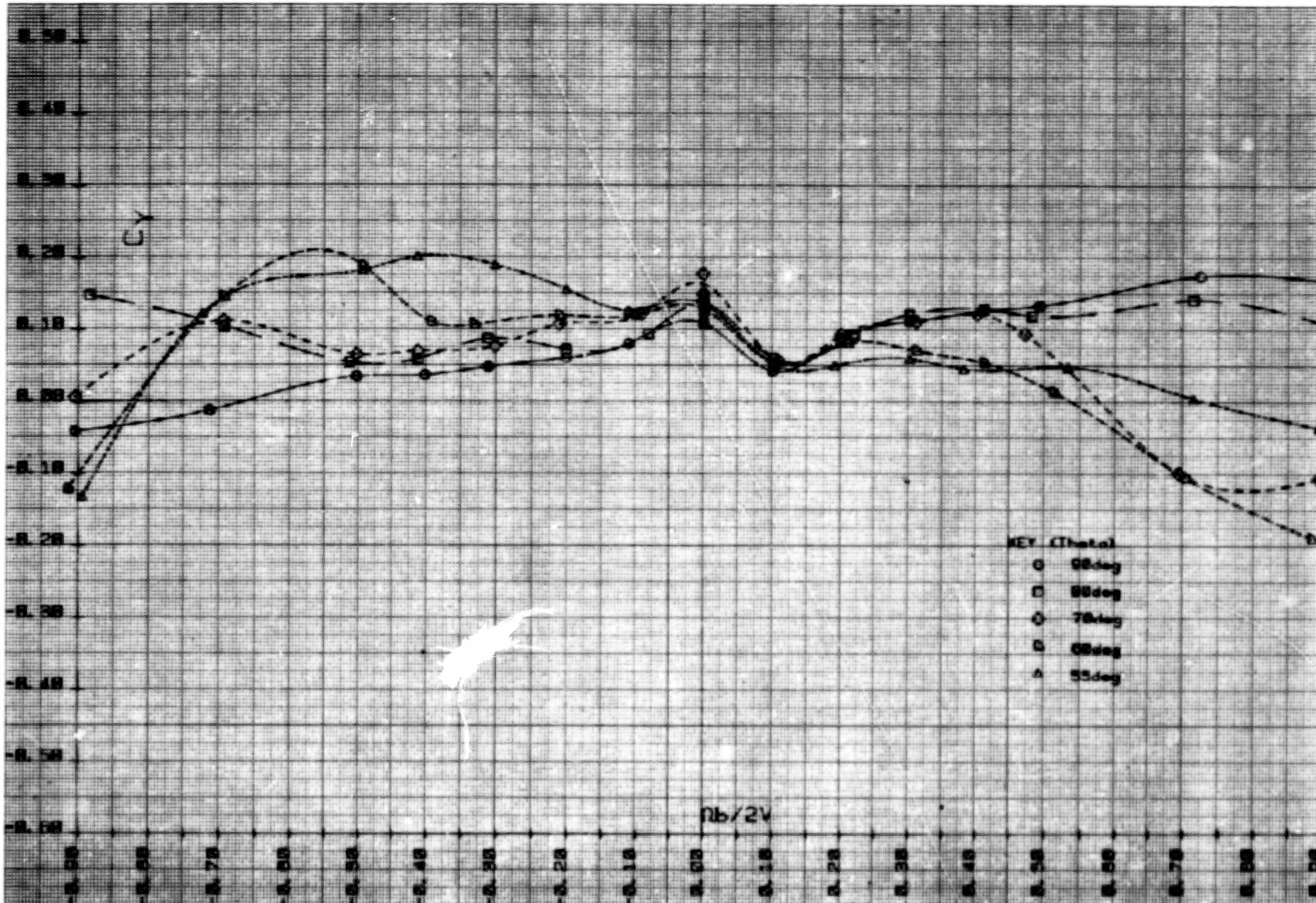


h.) Normal-force coefficient. Theta= 30 to 50deg; Phi=-0.6deg.

Figure 22. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+25r-25e.



ı.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.6deg.

Figure 22.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+25r-25e.

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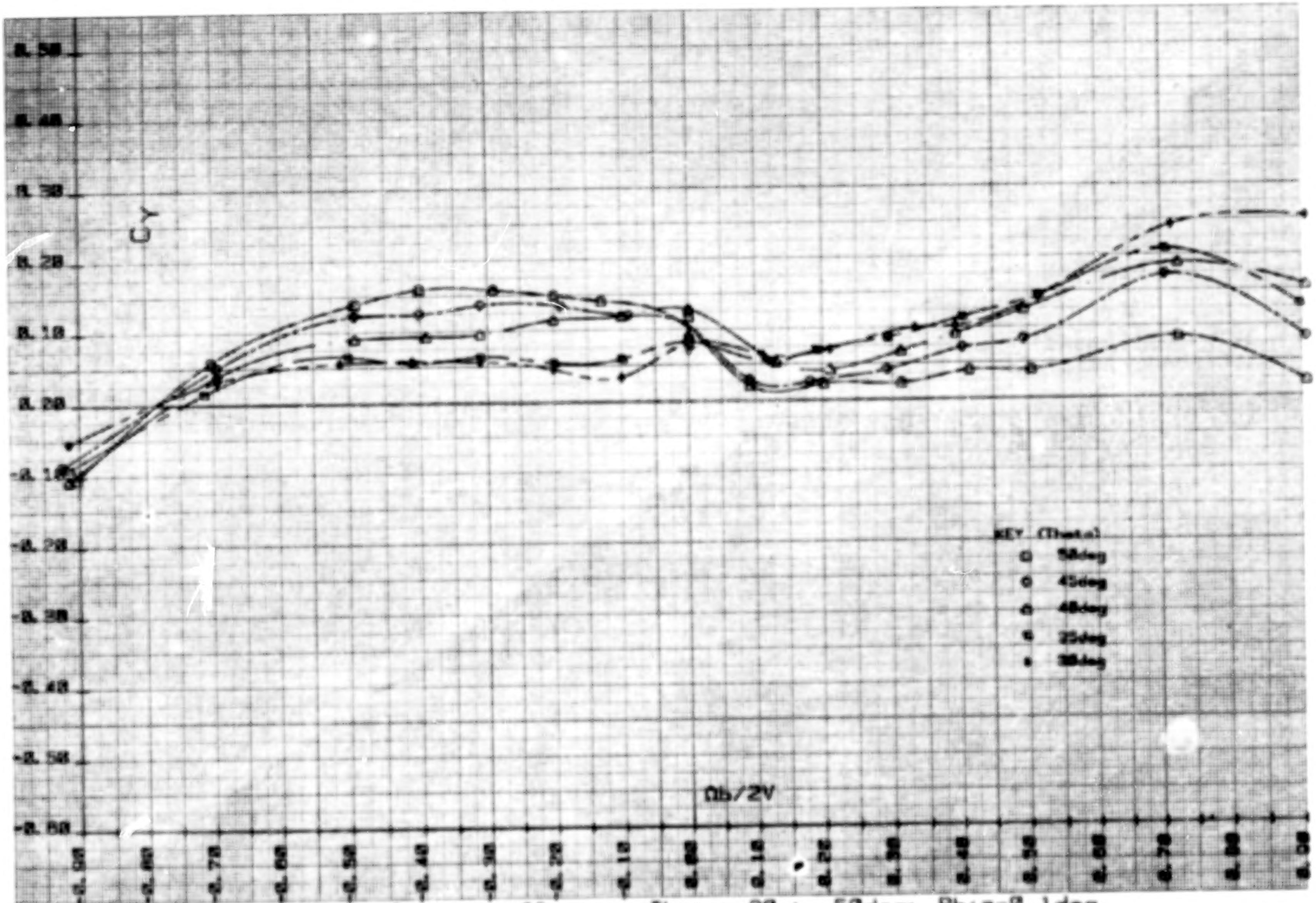
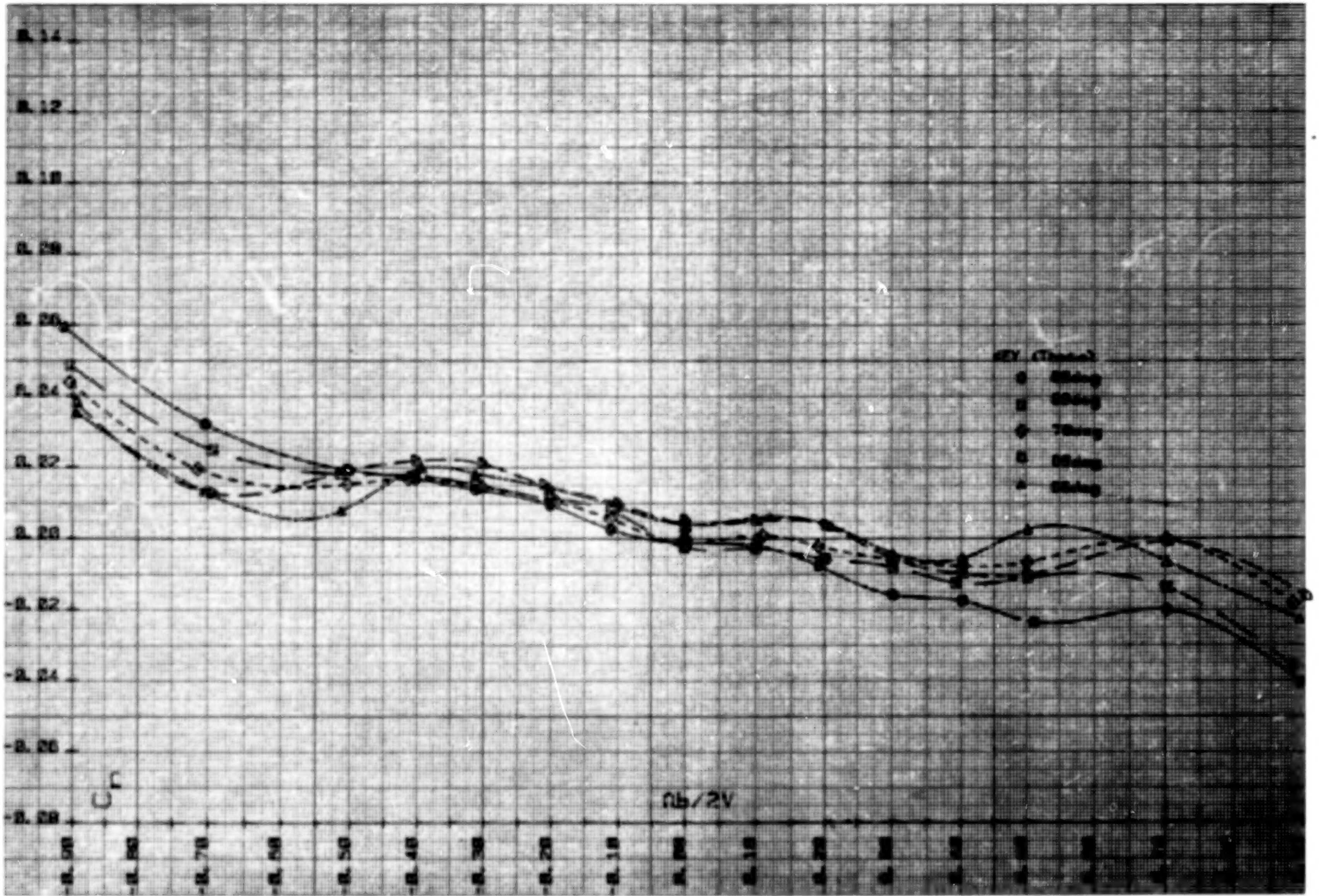


.)Side-force coefficient. Theta= 30 to 50deg; Phi=-0.1deg.

Figure 22.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+25r-25e.



a.) Yawing-moment coefficient. Theta= 55 to 90deg; Phi=-0.2deg.

Figure 23.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r.

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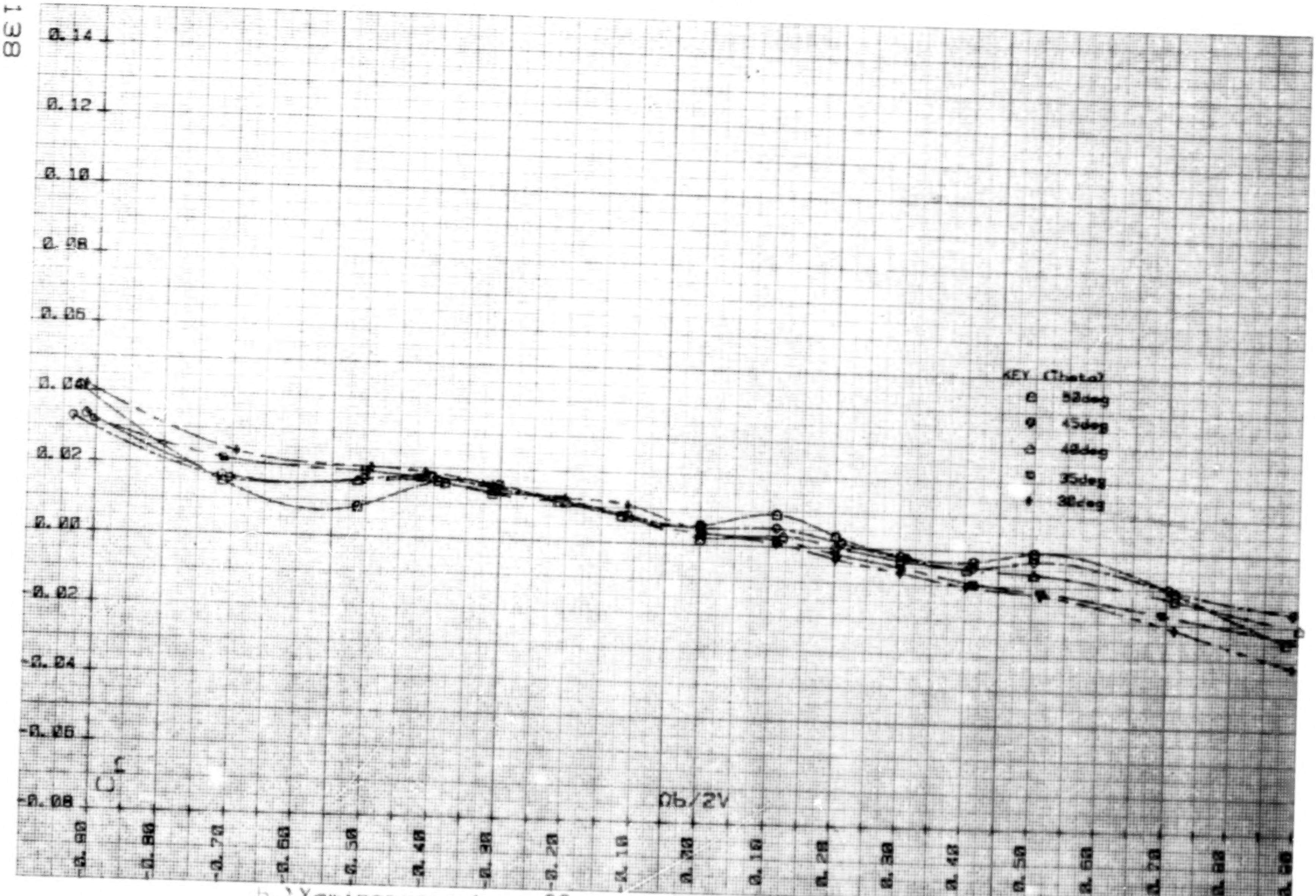
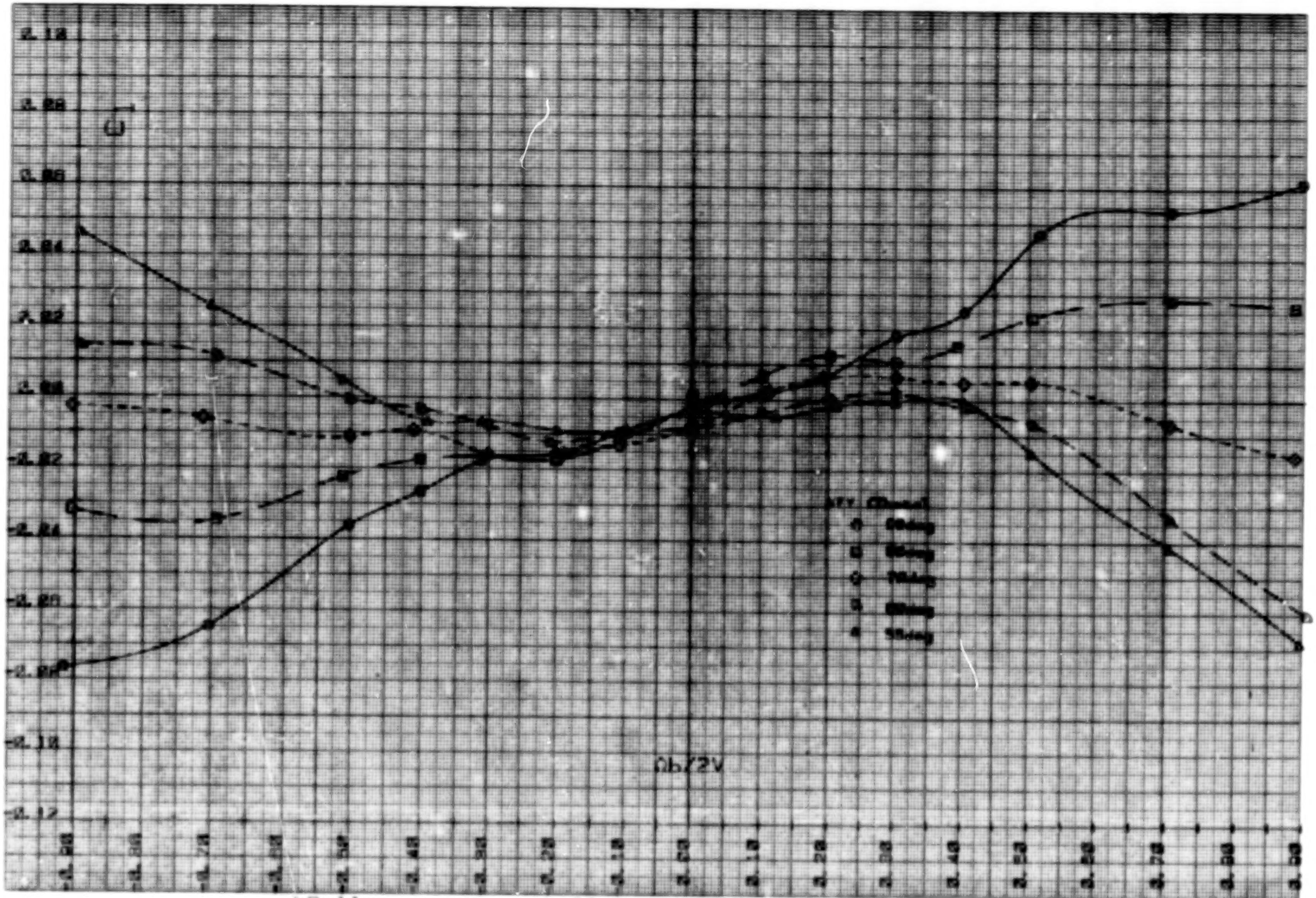


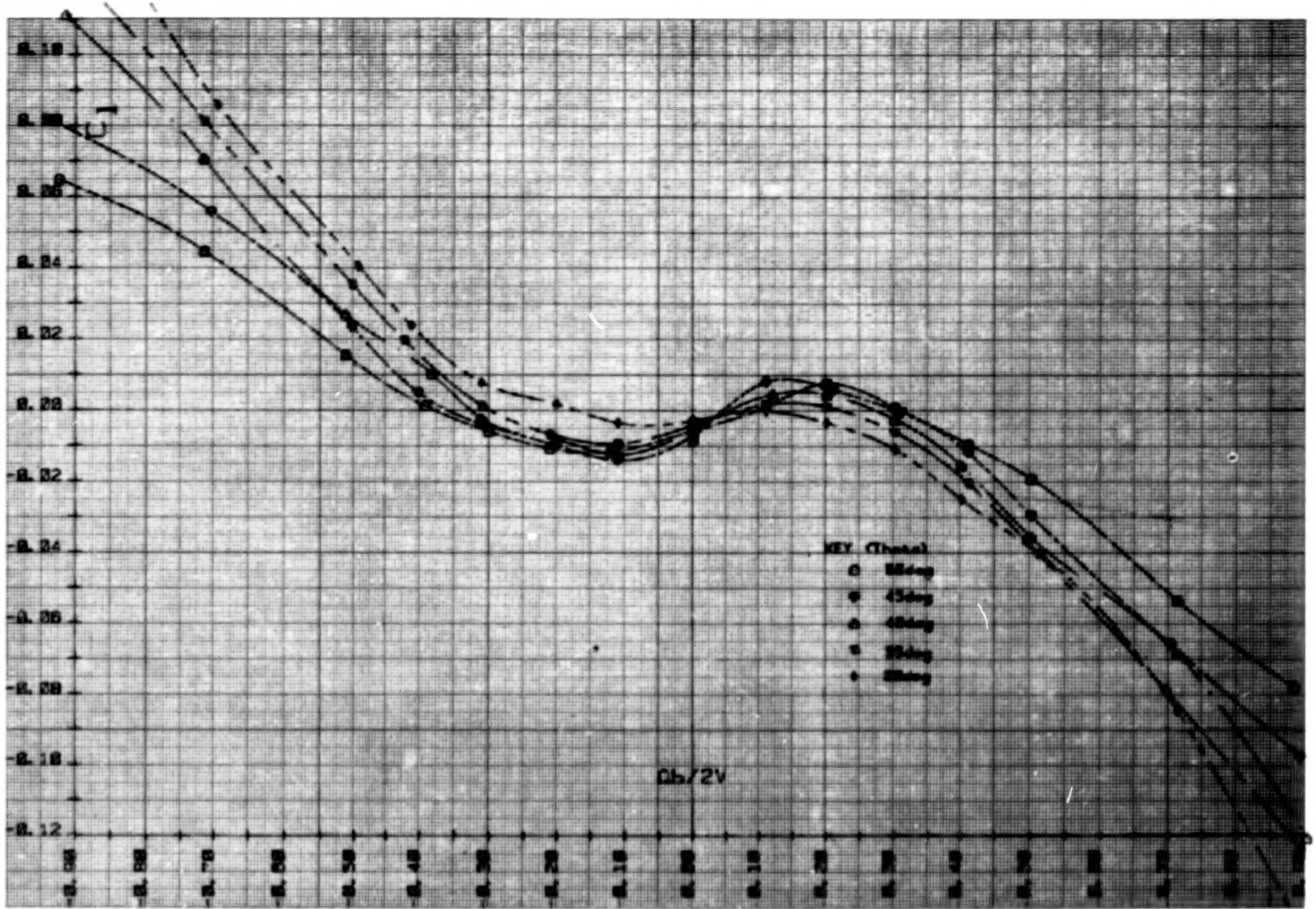
b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 23.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r.



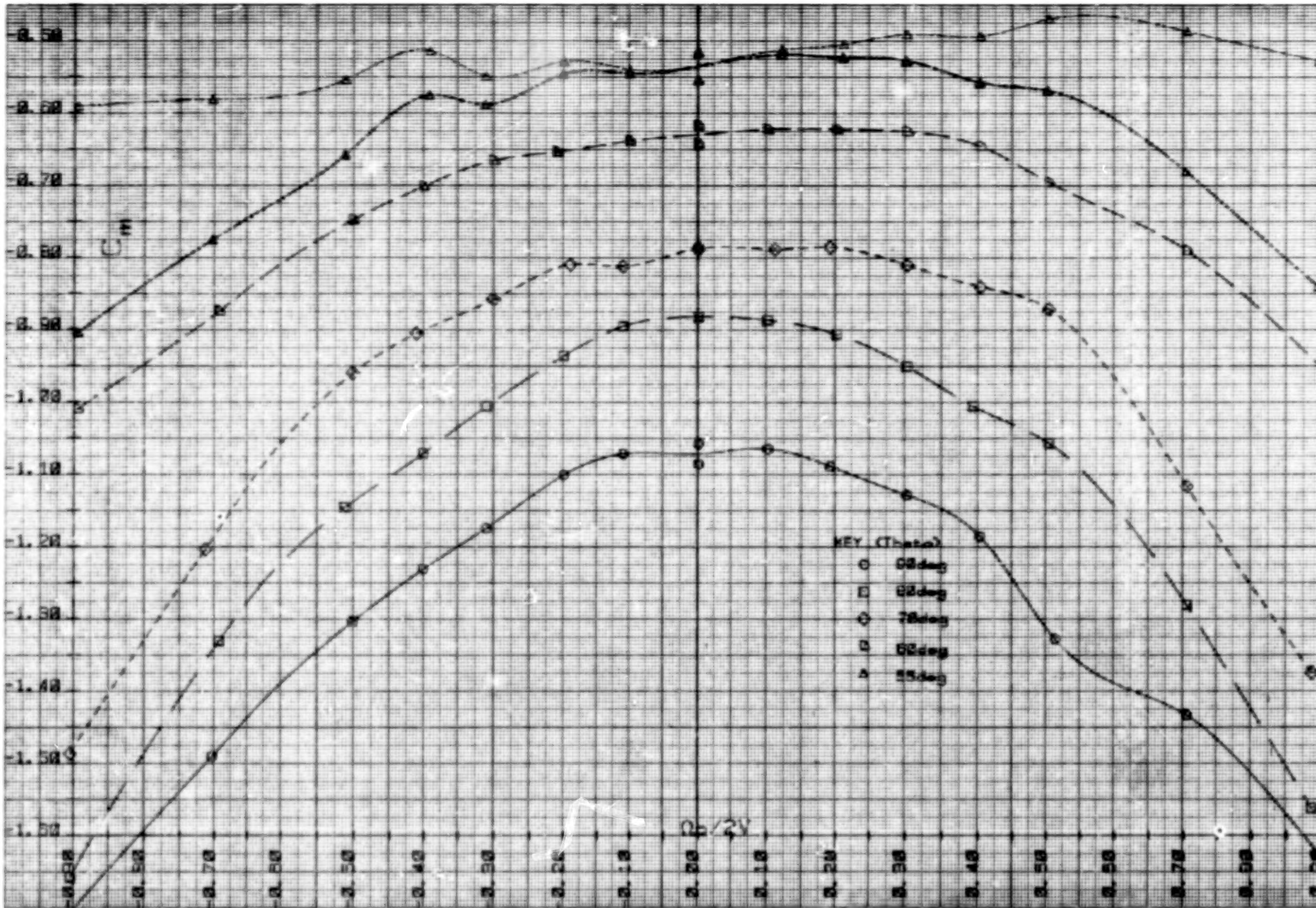
c.) Rolling-moment coefficient. Theta= 55 to 90deg; Phi=-0.2deg.

Figure 23.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r.



d.)Rolling-moment coefficient. Theta= 30 to 50deg; Phi=-0.4deg.

Figure 23.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r.



a.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 23.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r.

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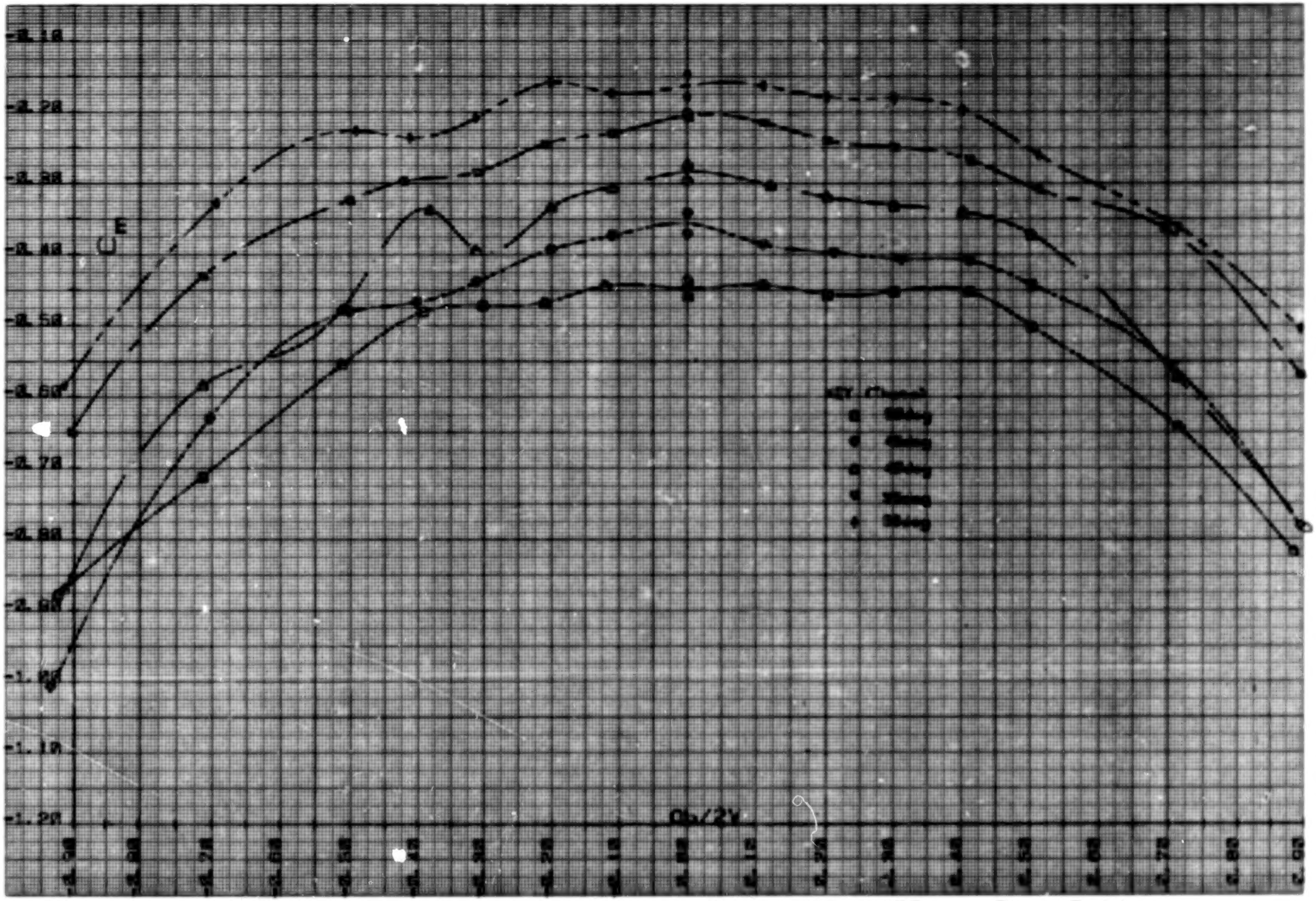
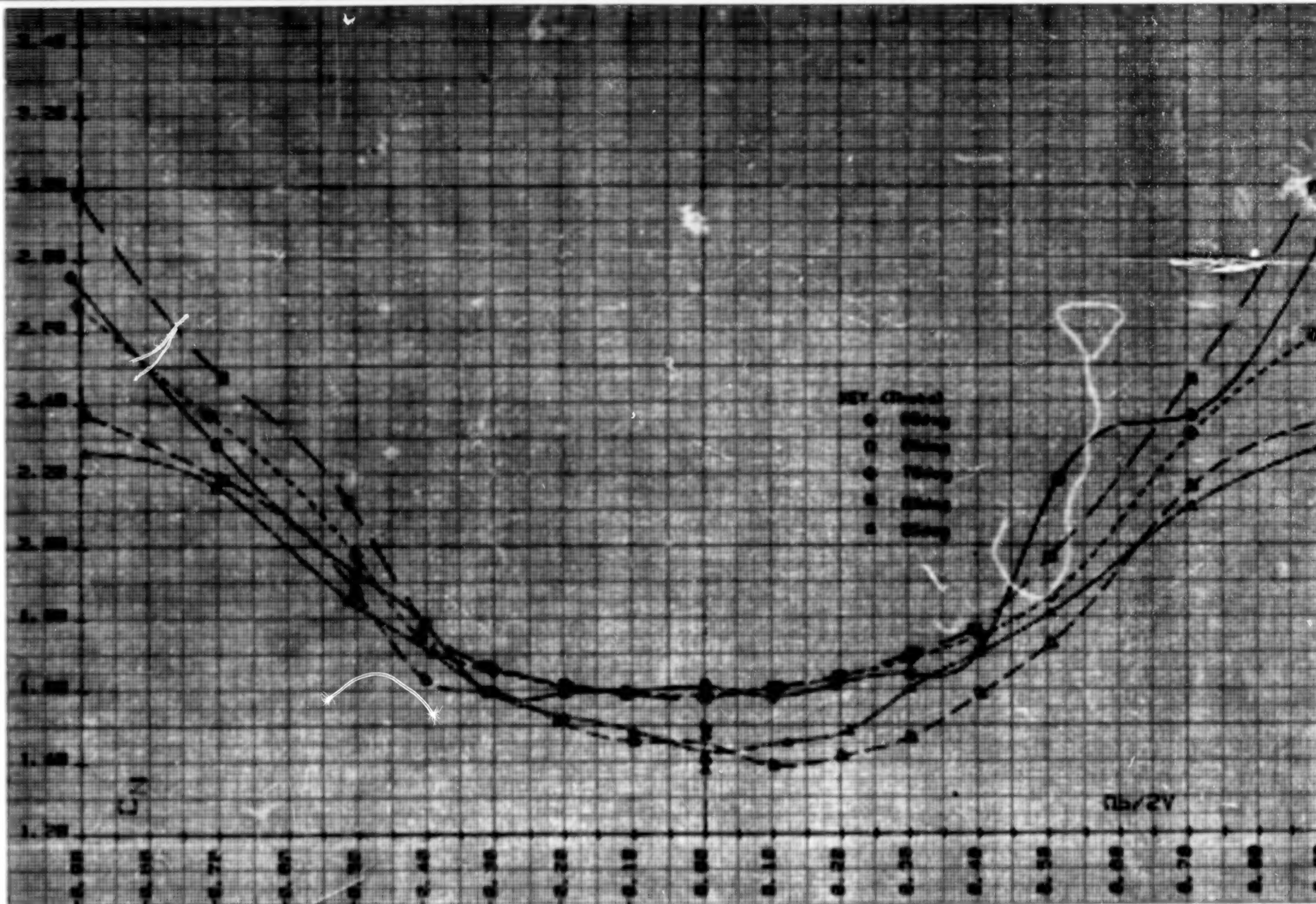


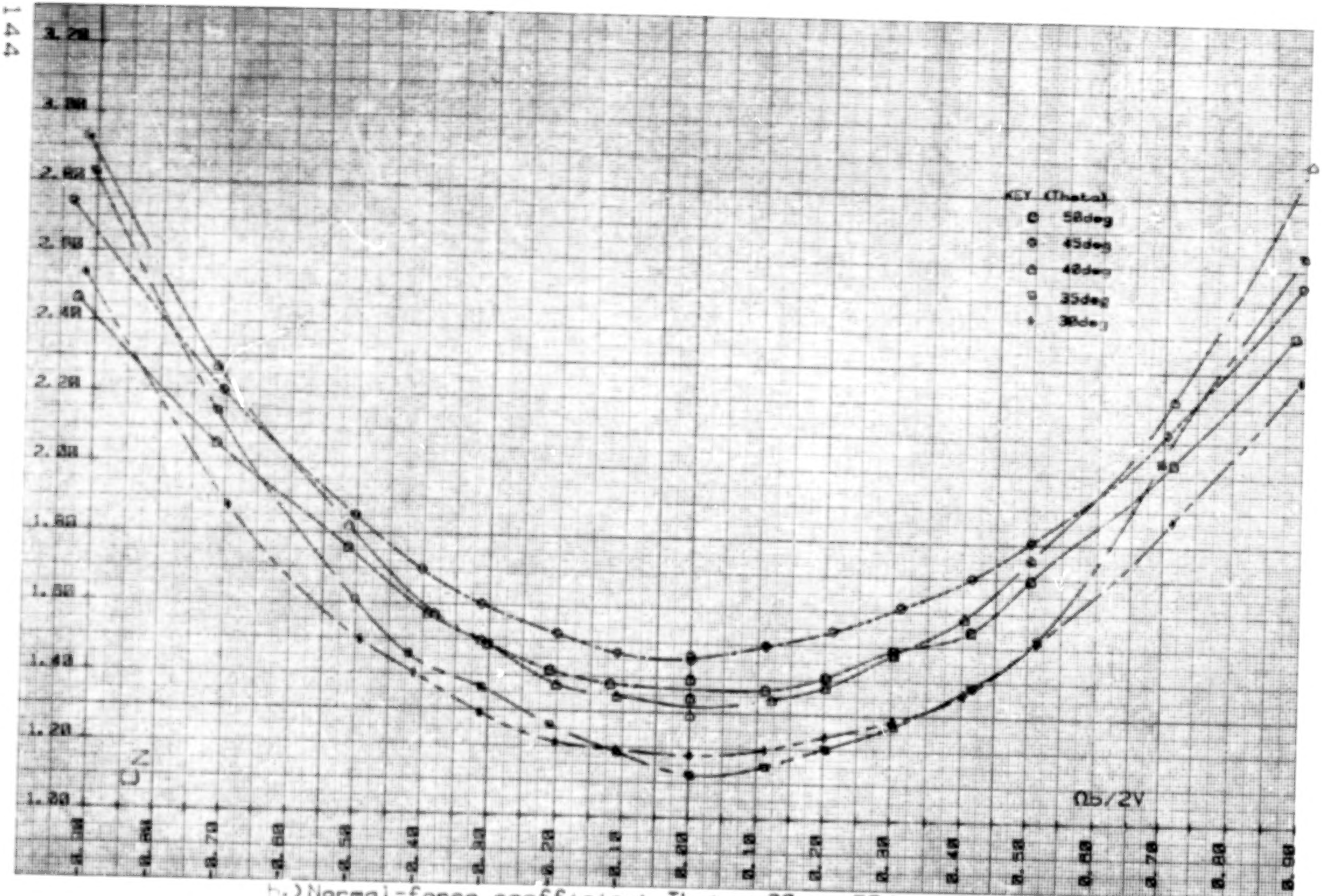
f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 23.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r.



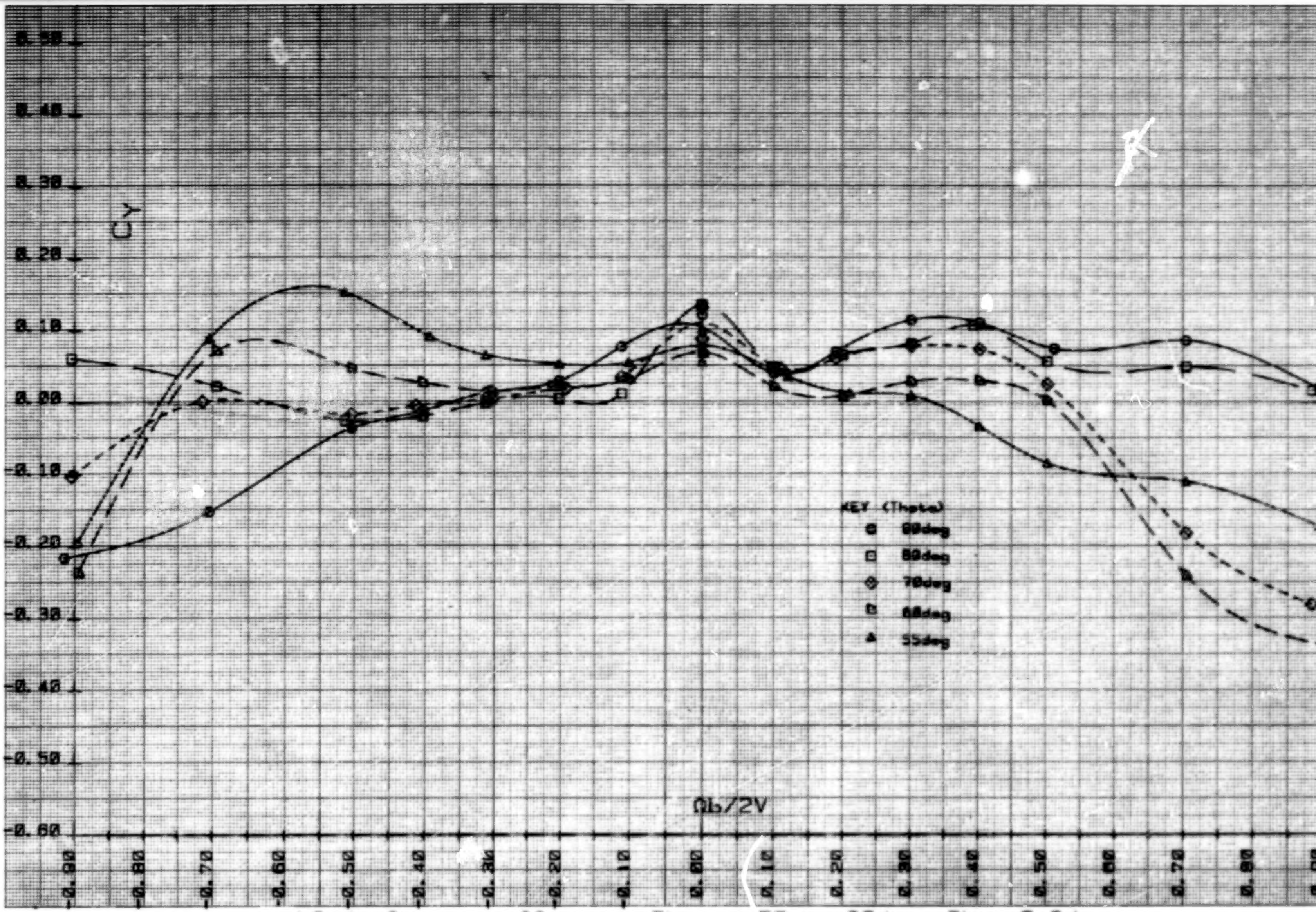
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 23.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r.



h.) Normal-force coefficient. Theta= 30 to 50deg; Phi=-0.4deg.

Figure 23.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r.



.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 23. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r.

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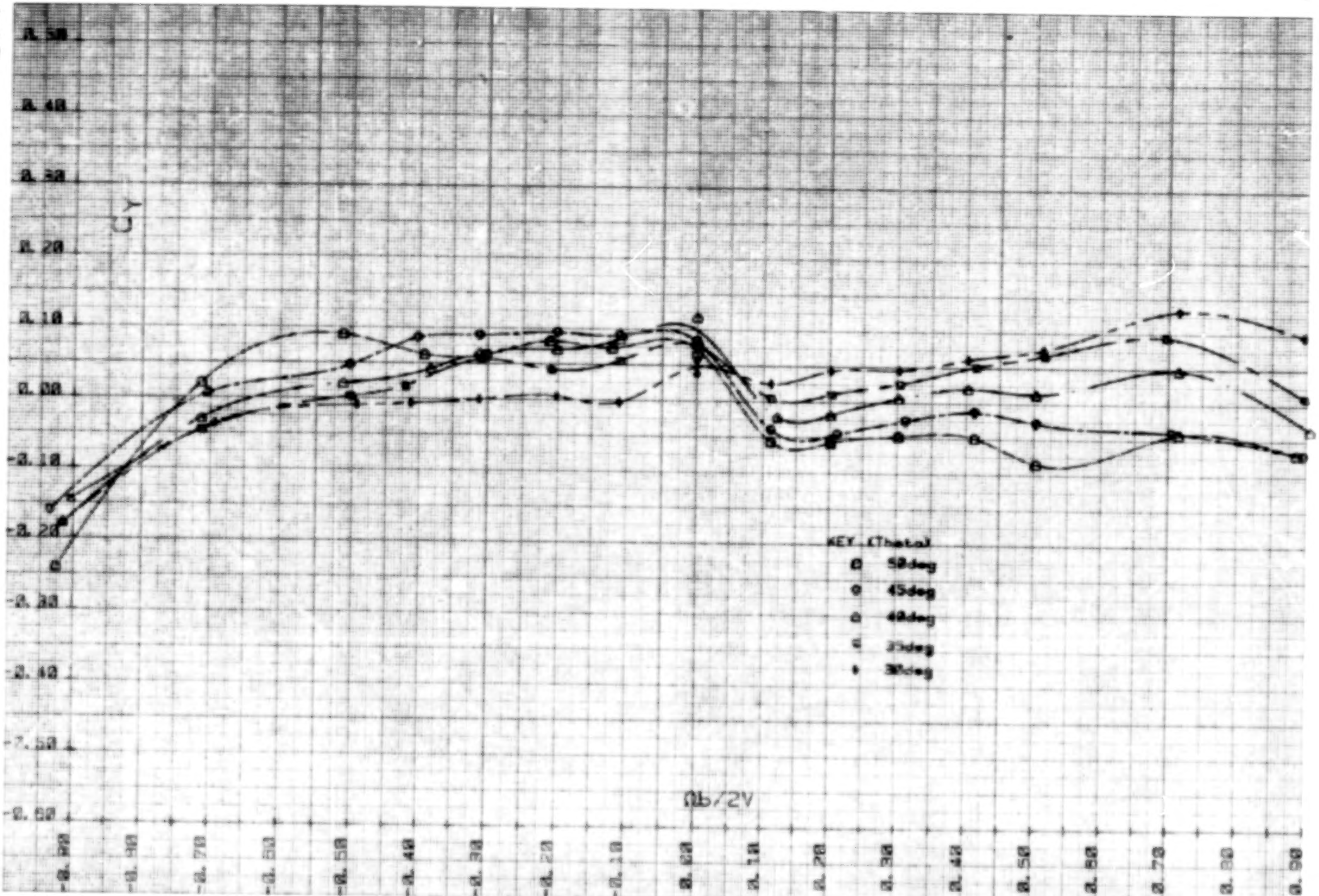
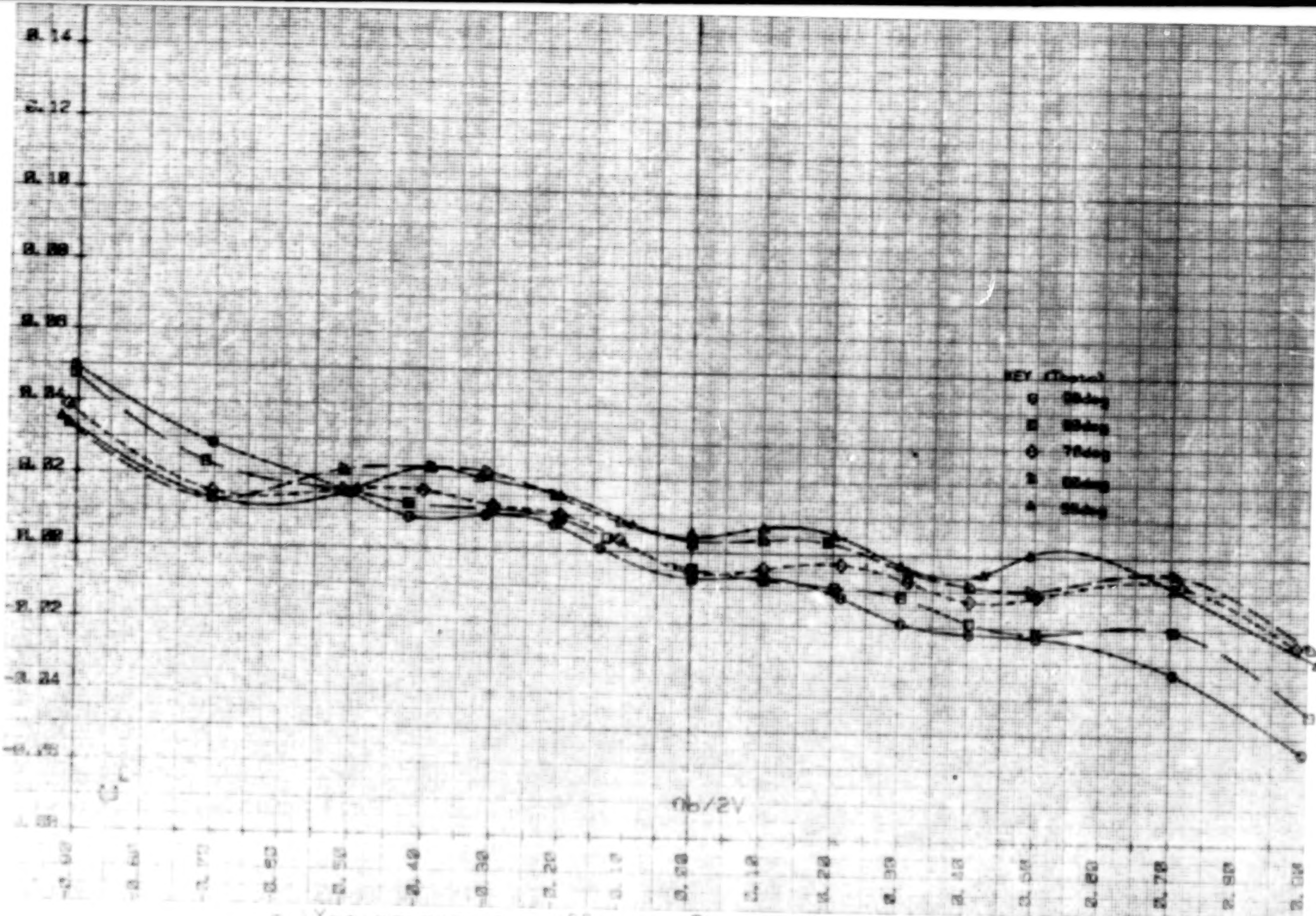


-) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 23.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r.



a.) Yawing moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure [illegible] Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r-22.5c.

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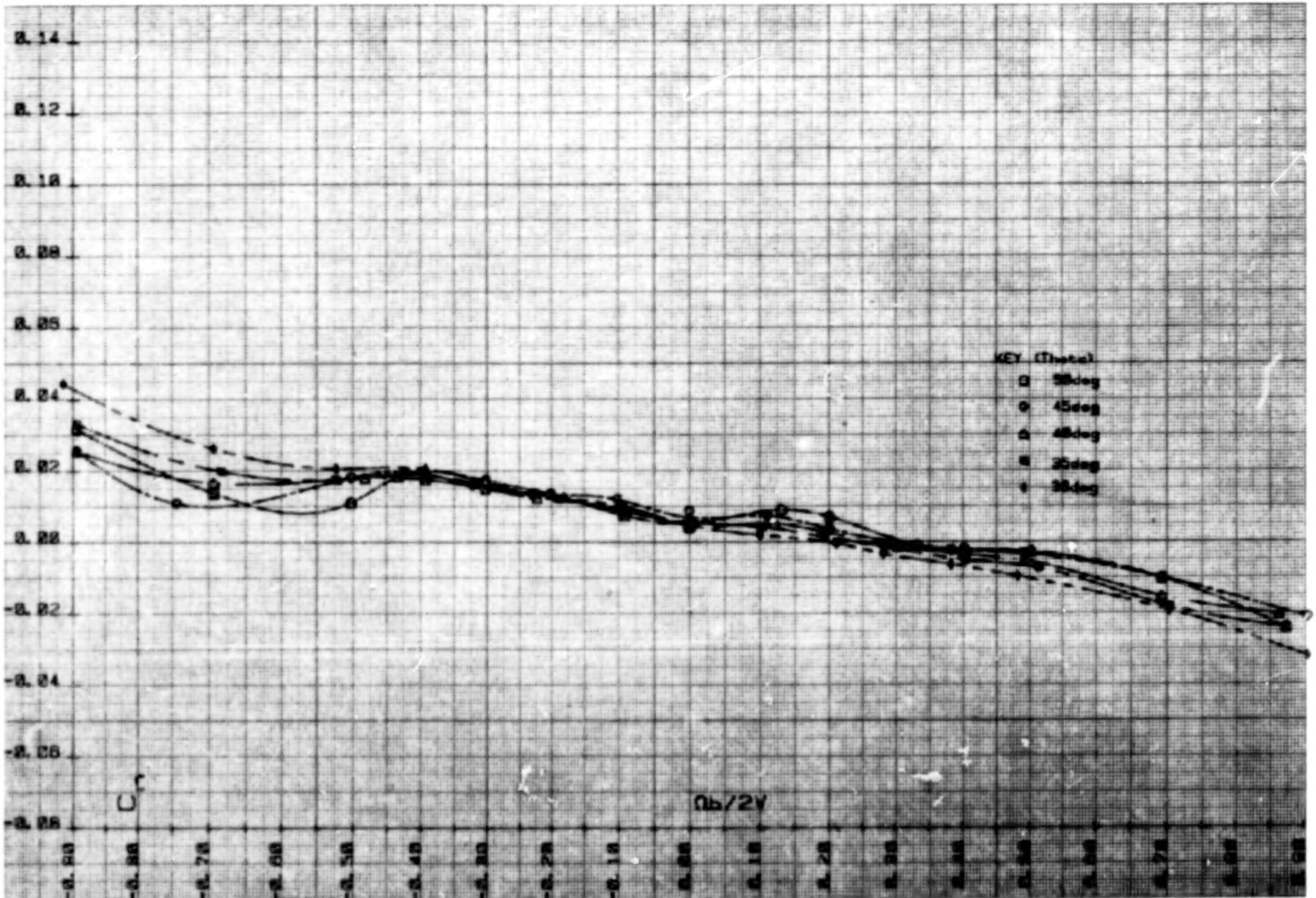
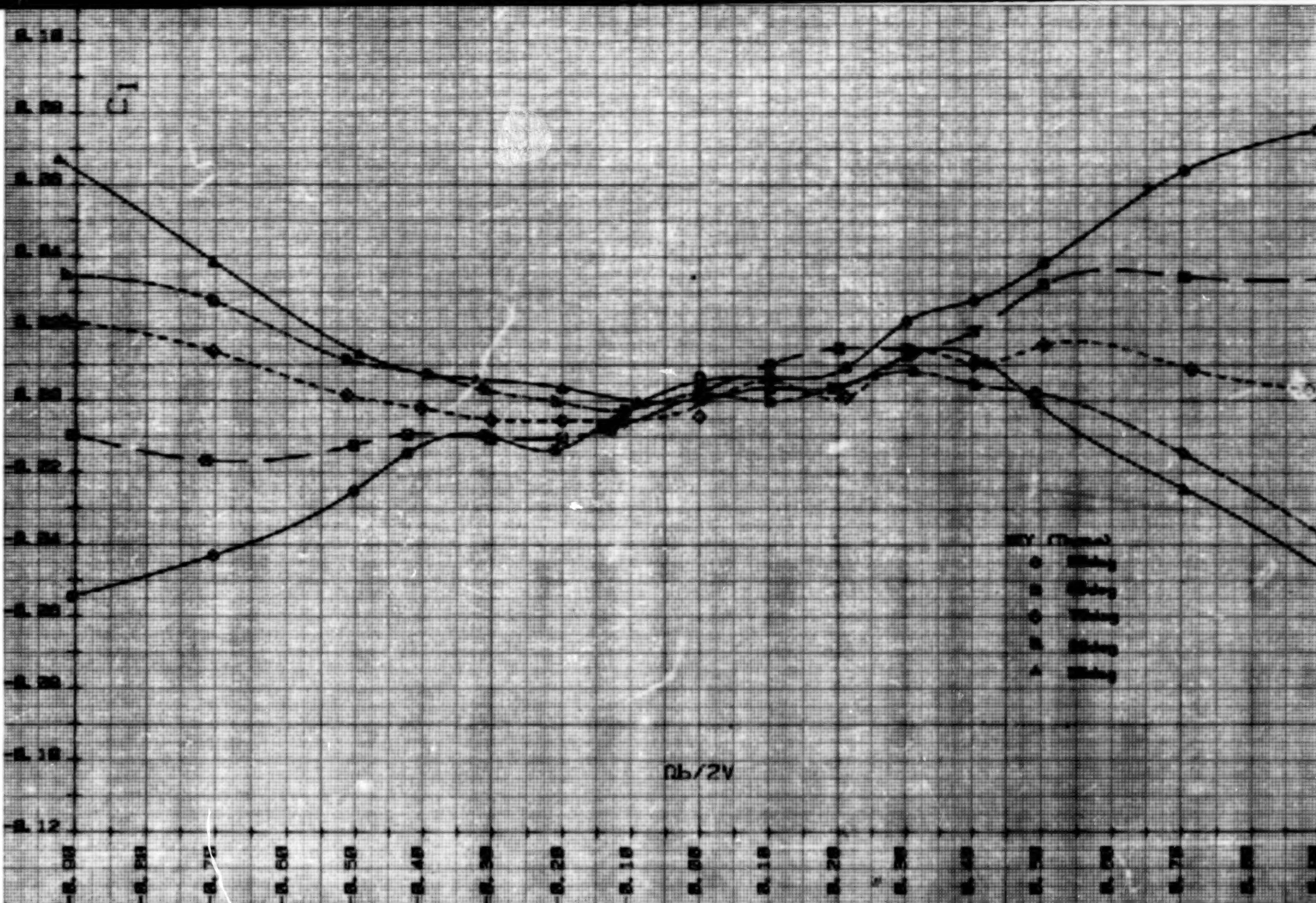


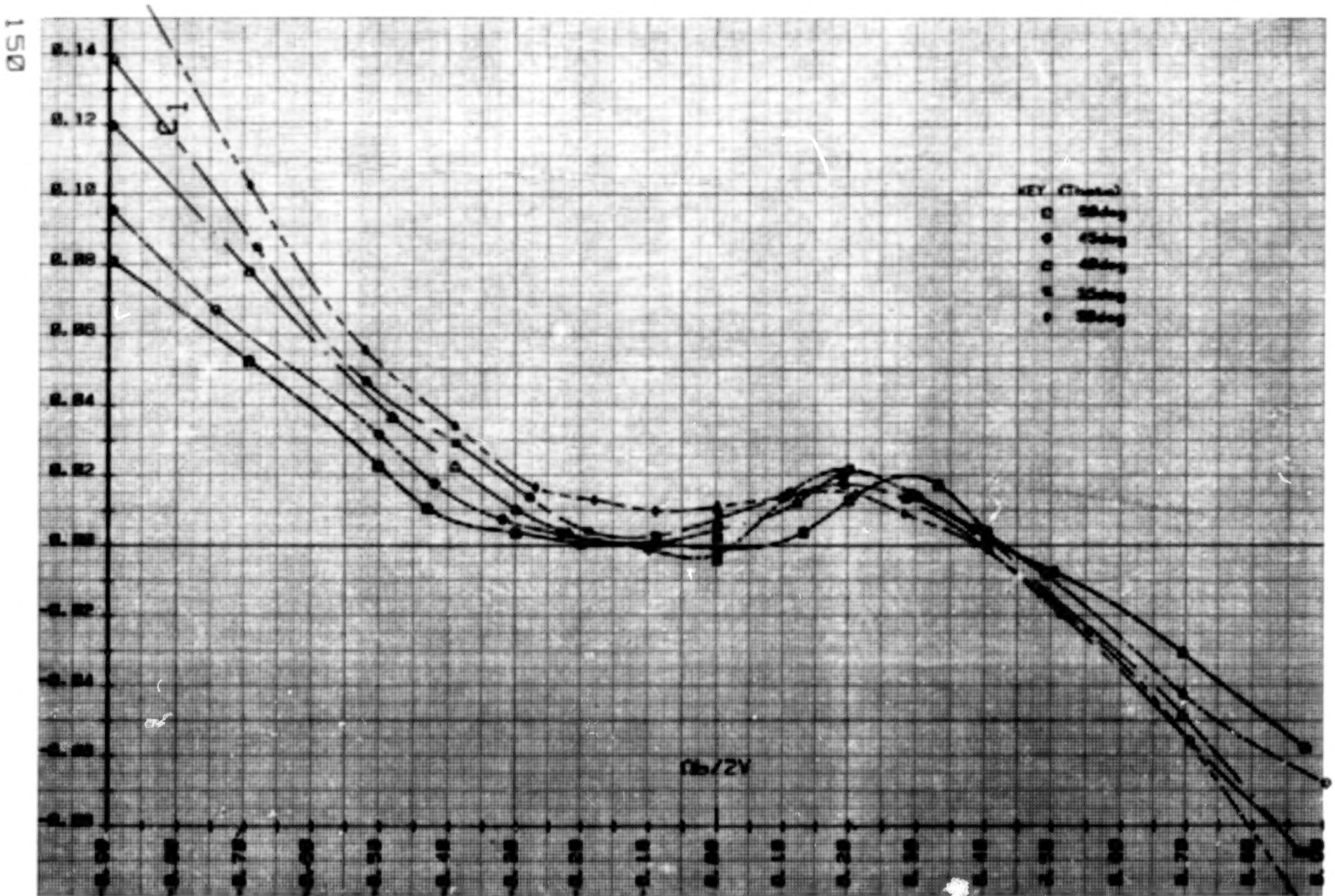
b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 24.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r-22.5a.



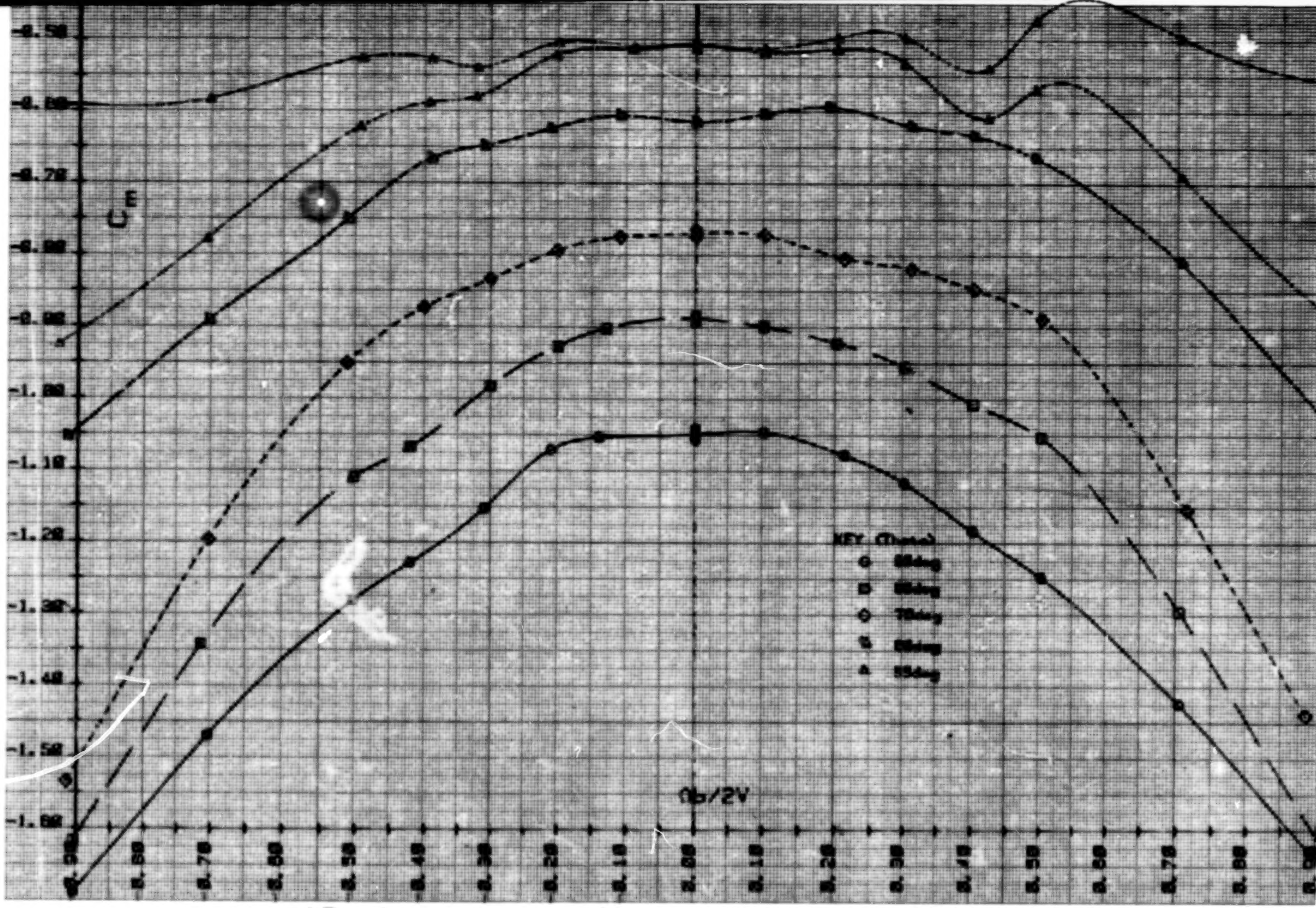
c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 24.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25a-25--22.5a.



d.)Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 24.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r-22.5a.



a.)Pitching-moment coefficient. Theta= 55 to 90deg: Phi=-0.2deg.

Figure 24.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r-22.5a.

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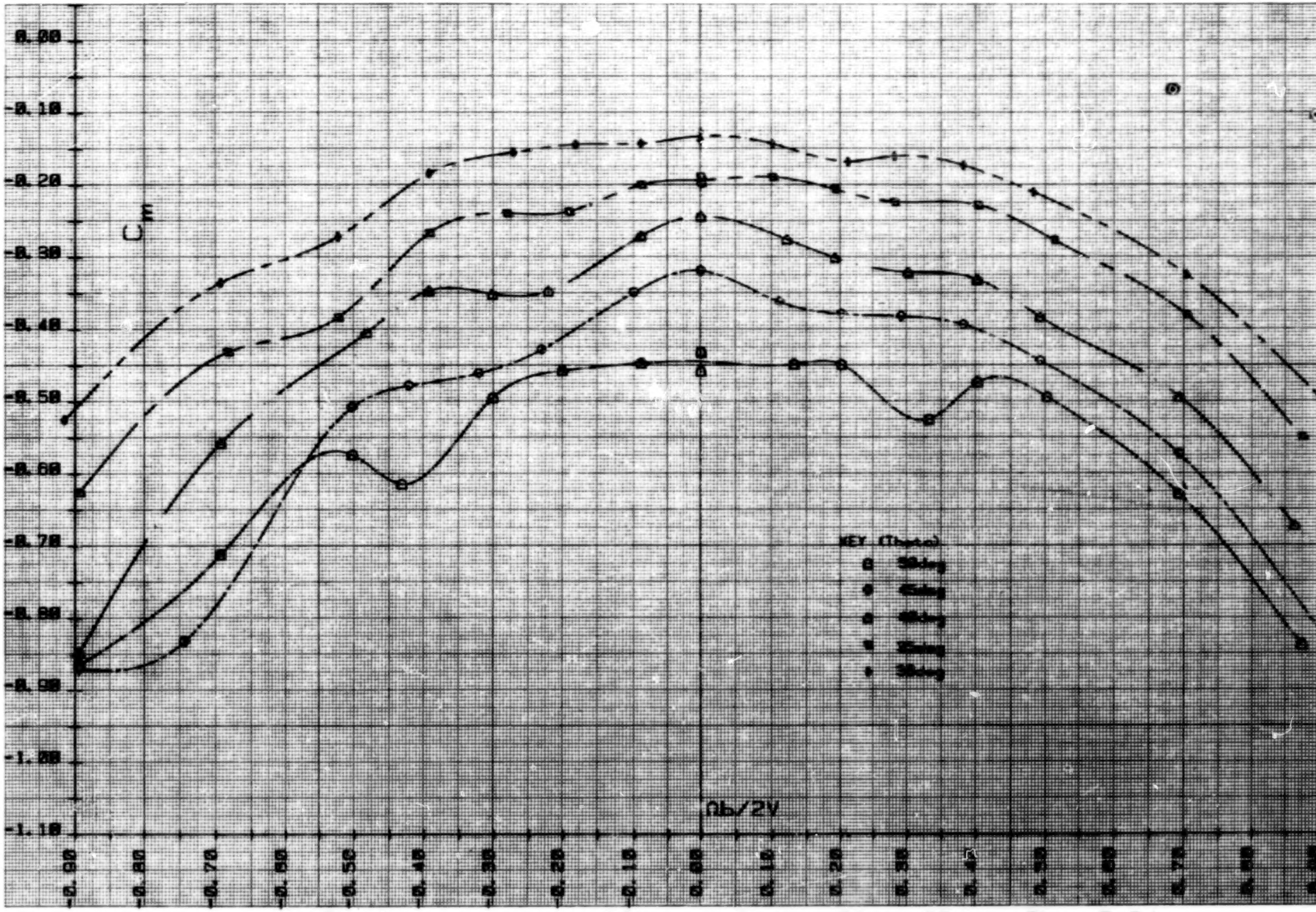
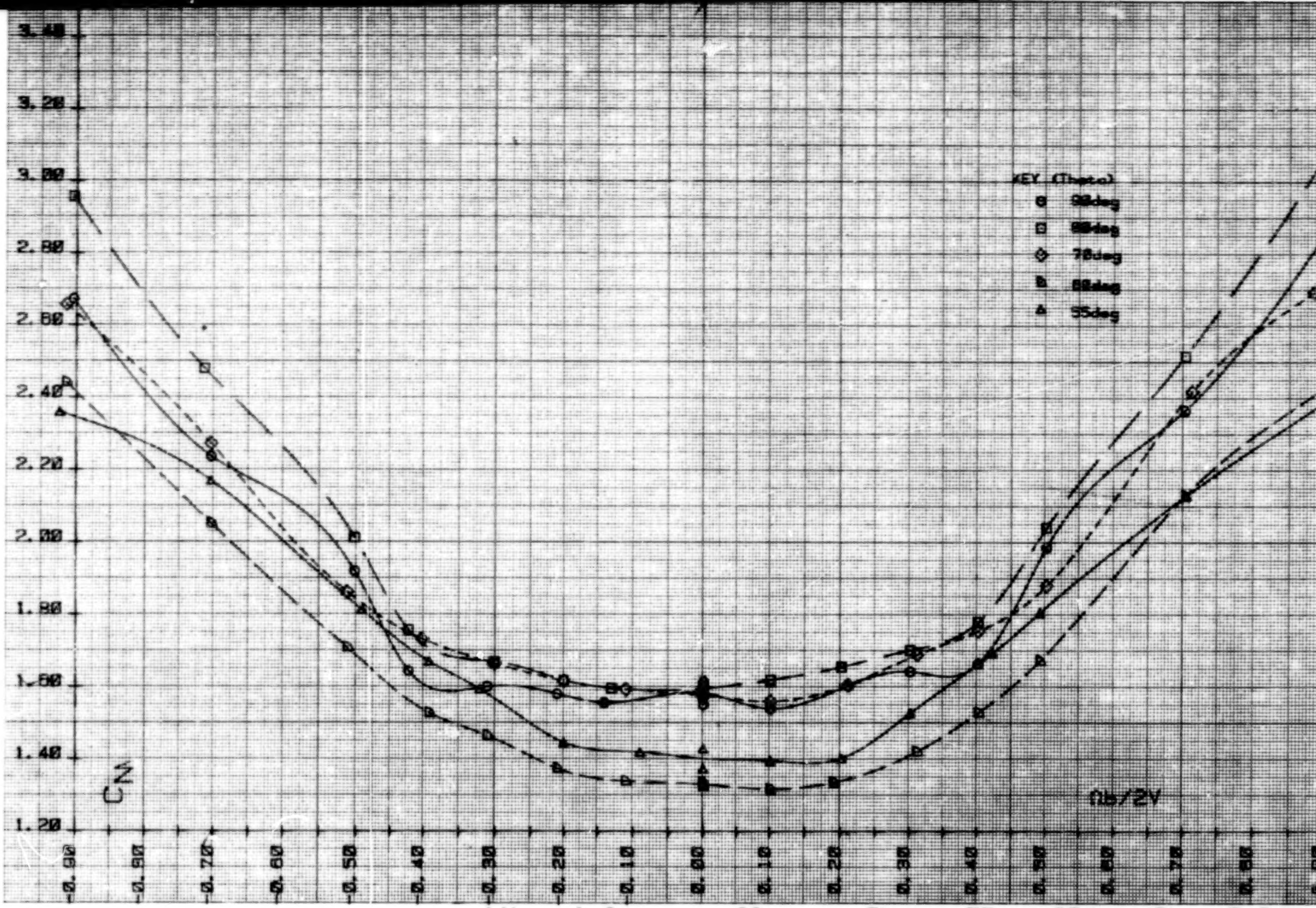


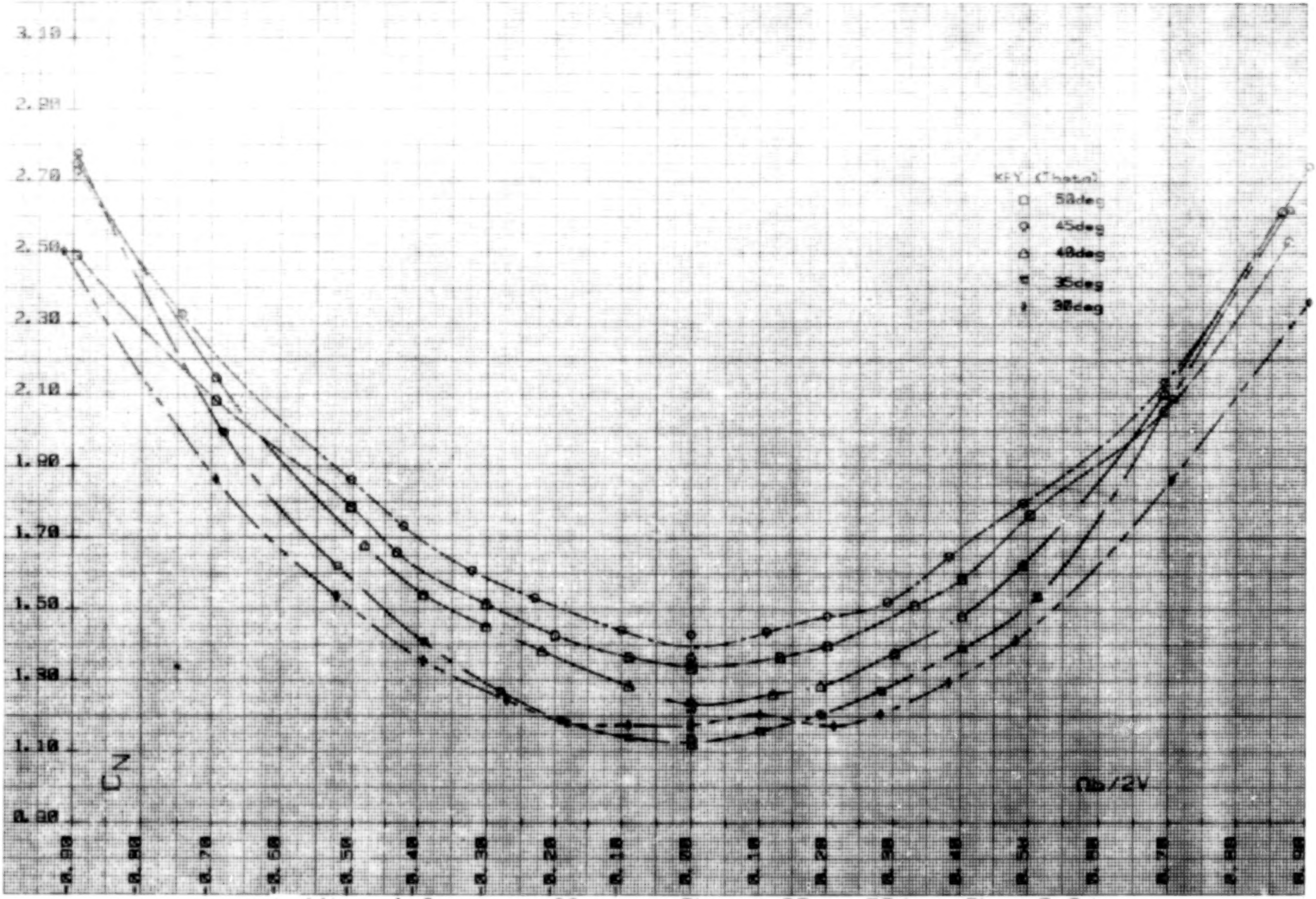
f.)Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 24.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r-22.5a.



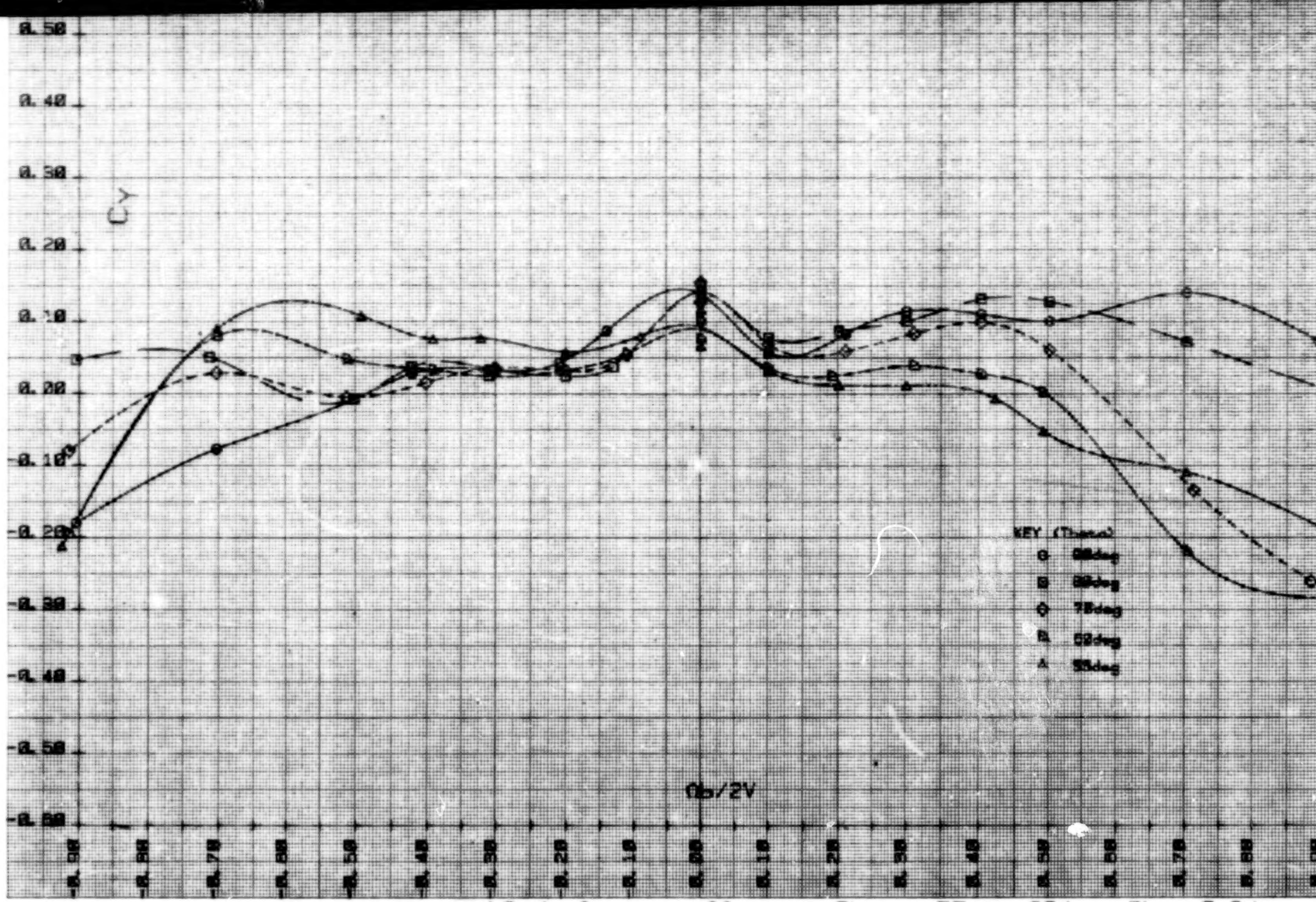
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 24.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r-22.5a.



h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 24.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r-22.5a.



(.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 24.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r-22.5a.

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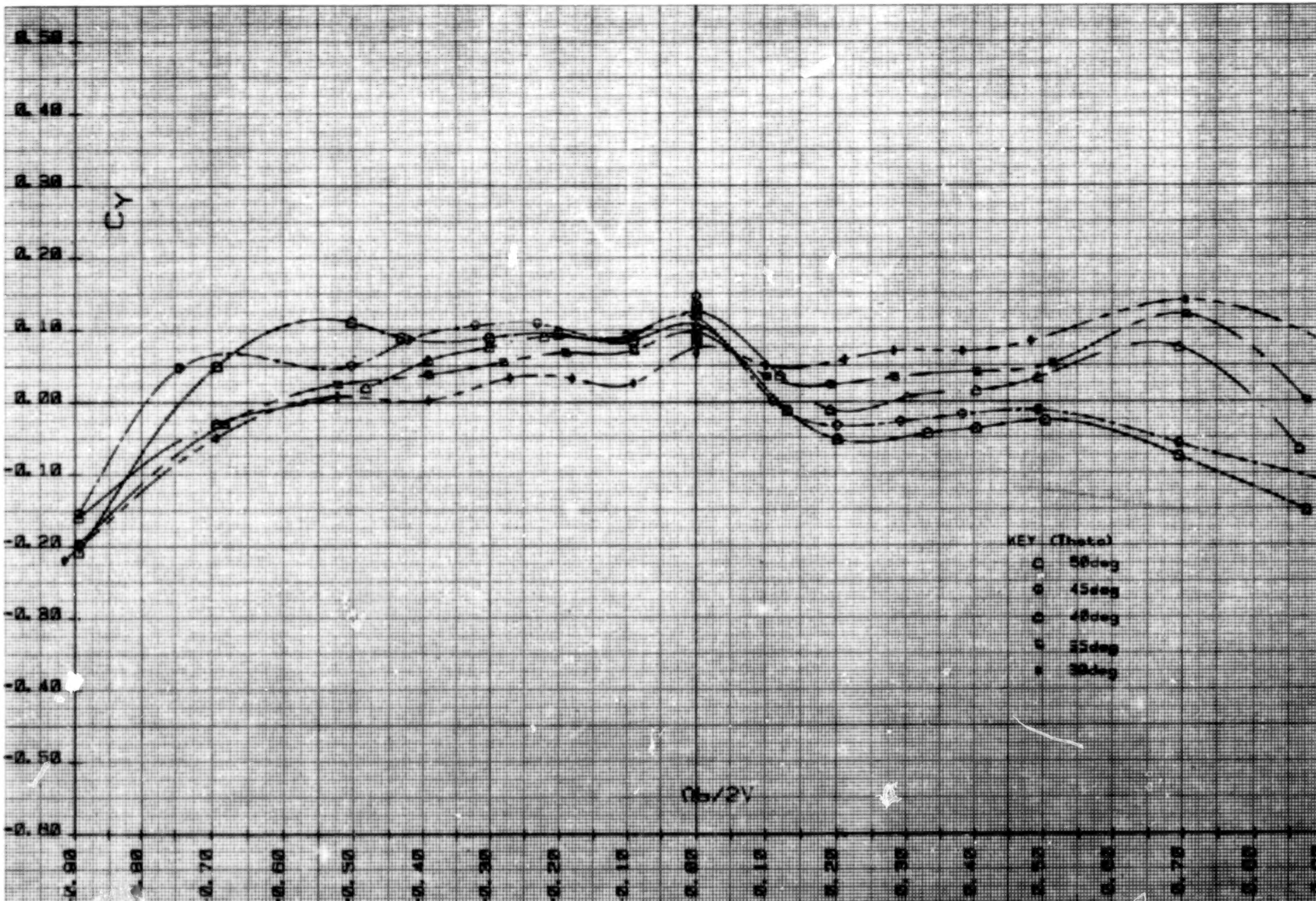
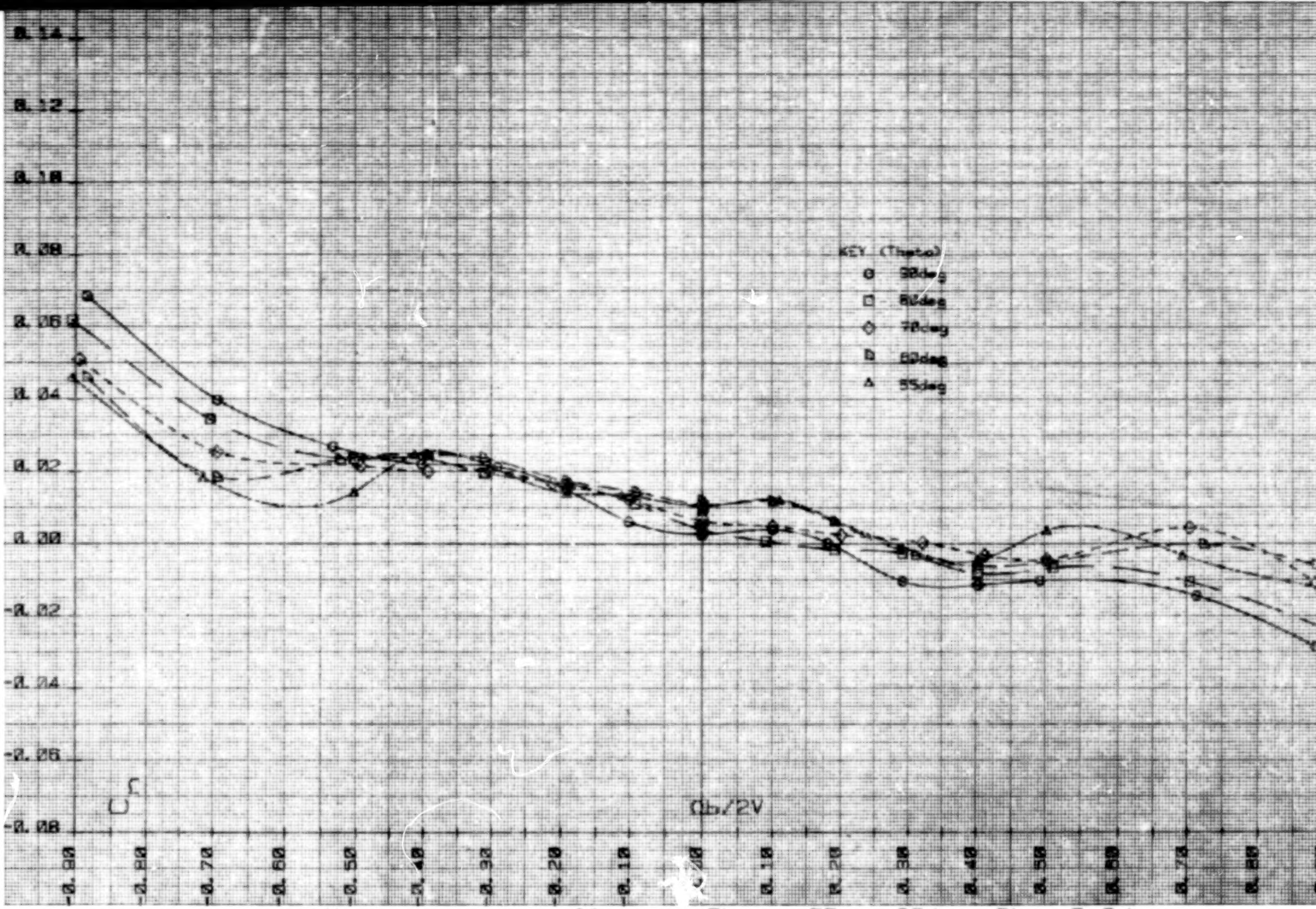


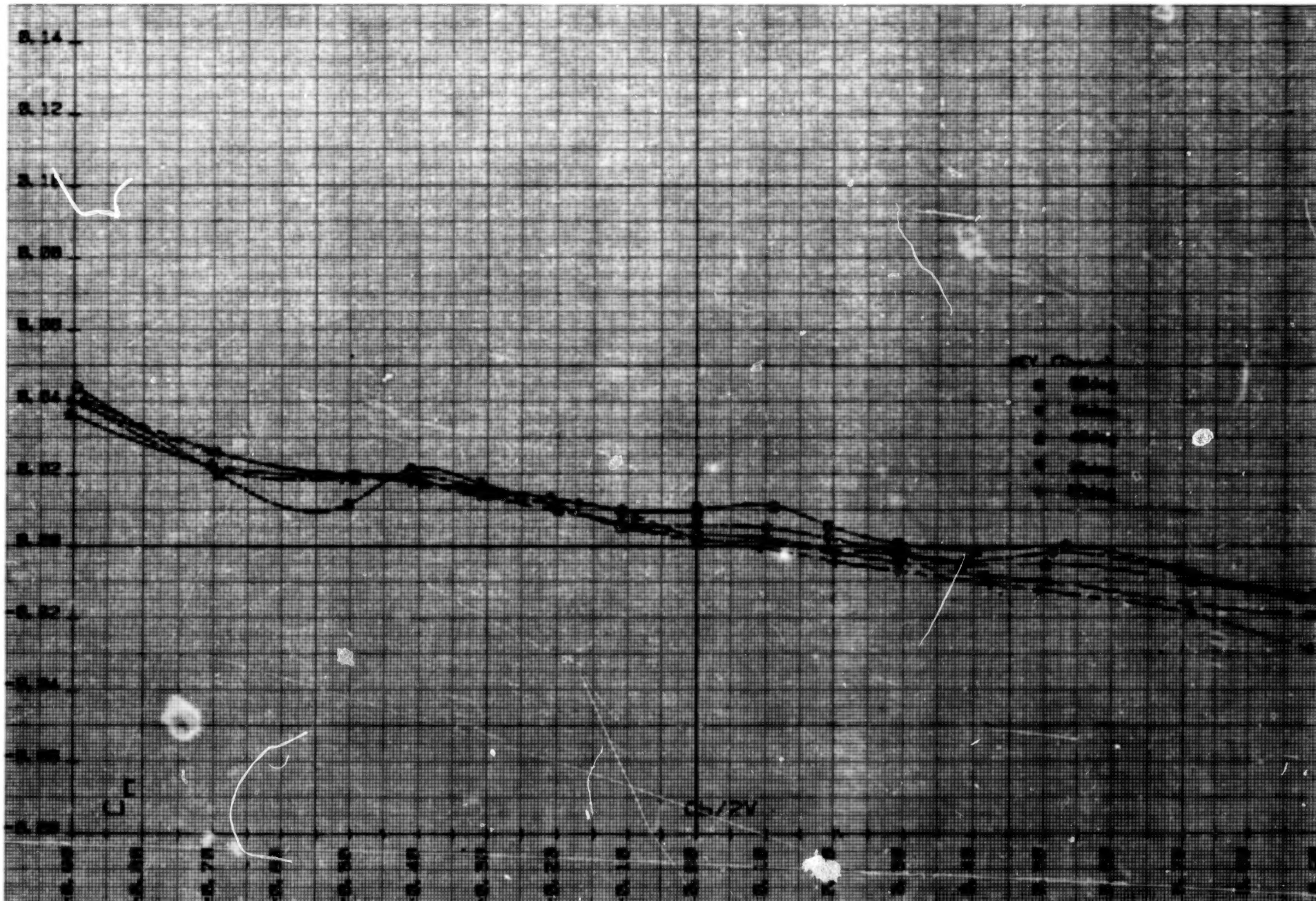
j.) Side-force coefficient, Theta= 30 to 50deg: Phi=-0.2deg.

Figure 24. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r-22.5a.



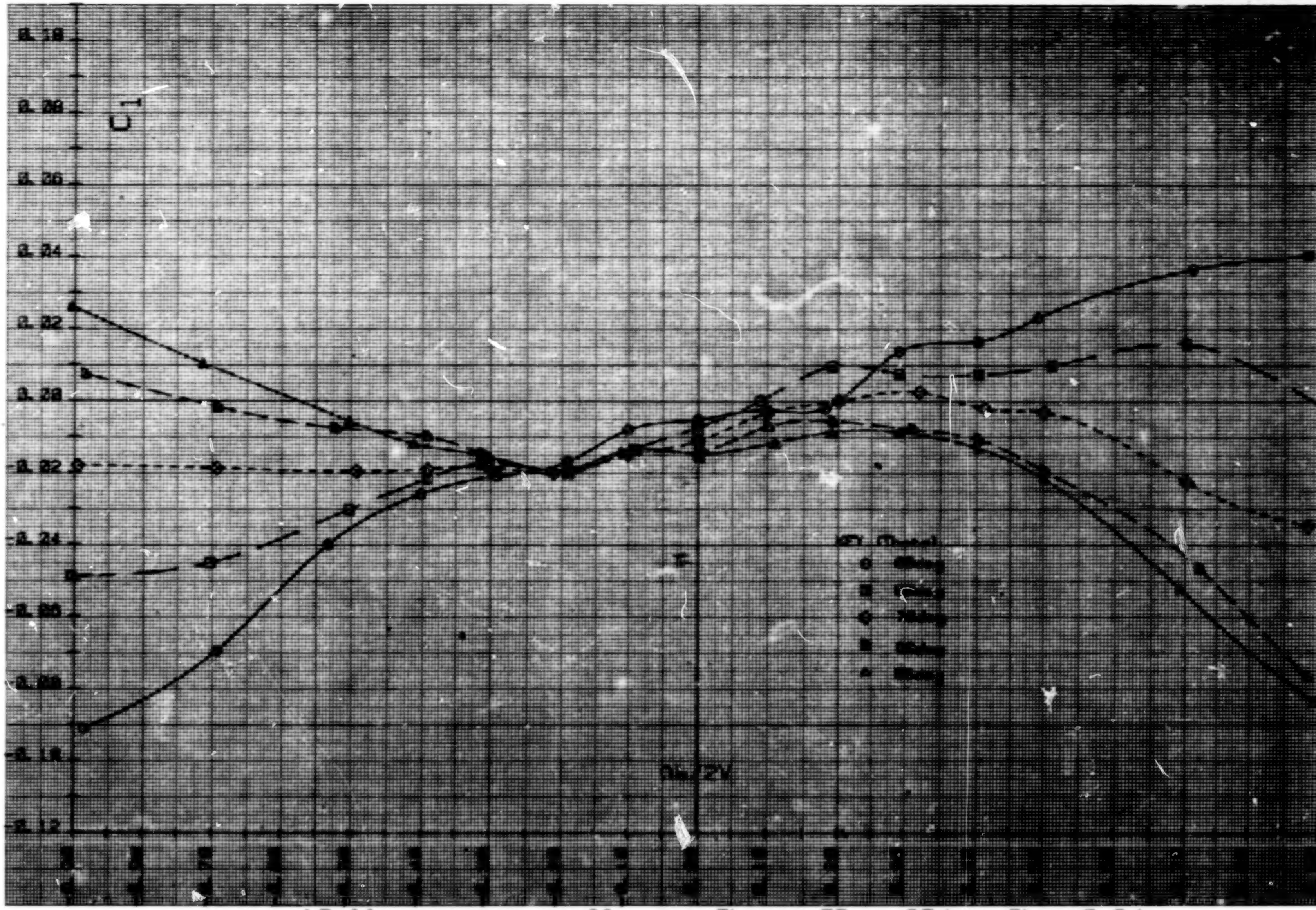
a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 25.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r+22.5a.



b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.8deg.

Figure 25. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic
... configuration BW1H3V-25e-25r+22.5a.



c.) Rolling-moment coefficient. Theta= 55 to 90deg; Phi=-0.2deg.

Figure 25. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r+22.5a.

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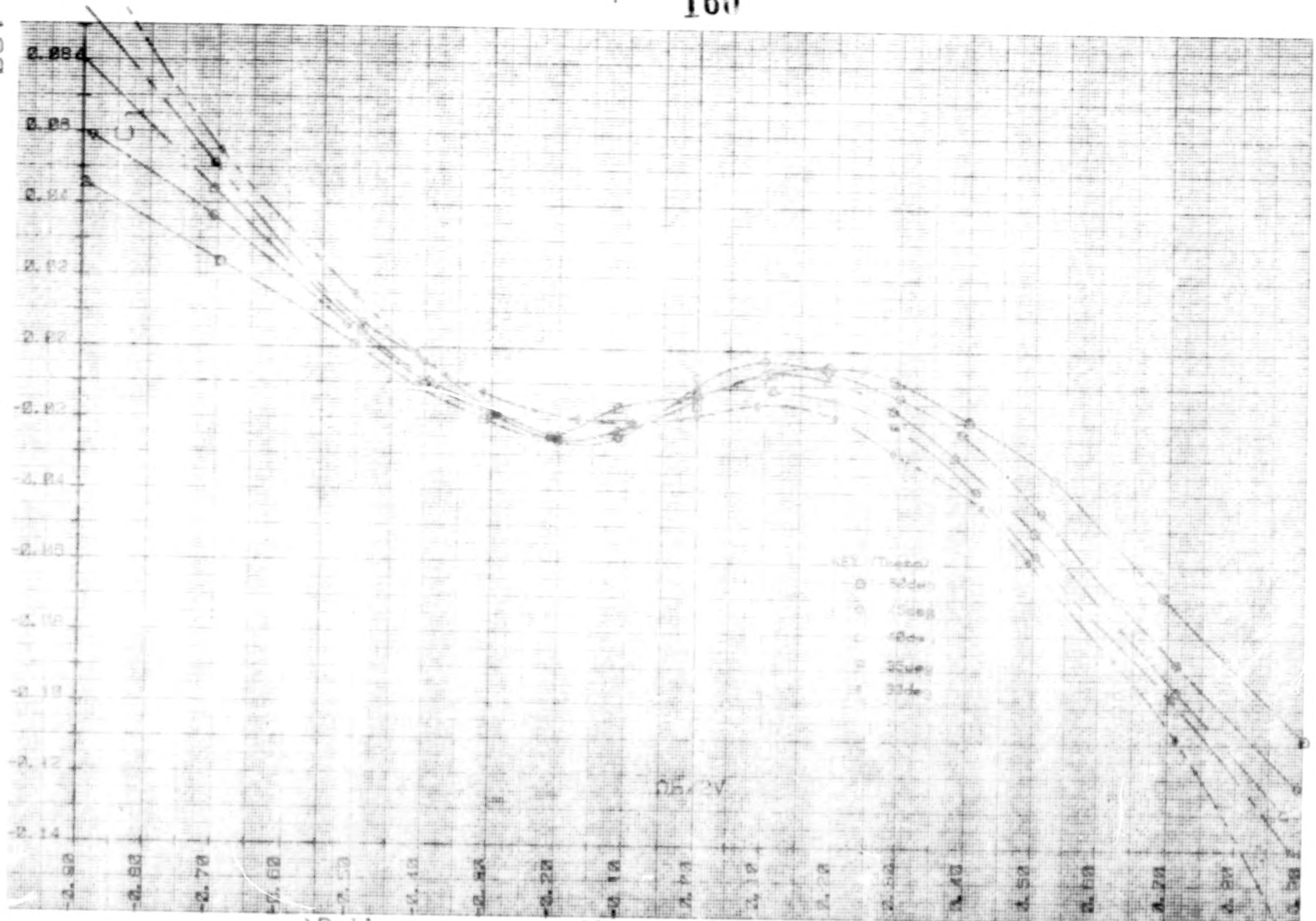
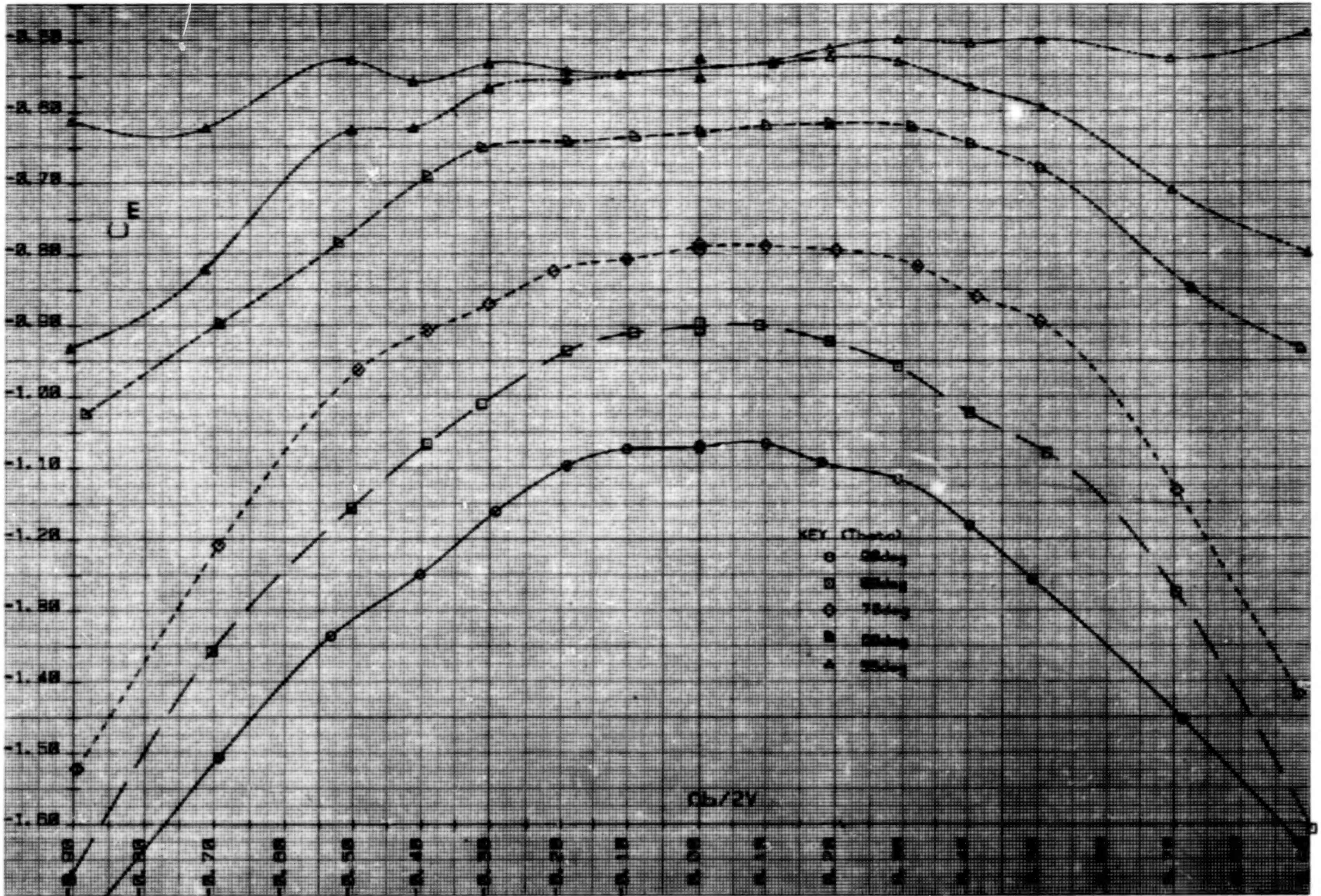


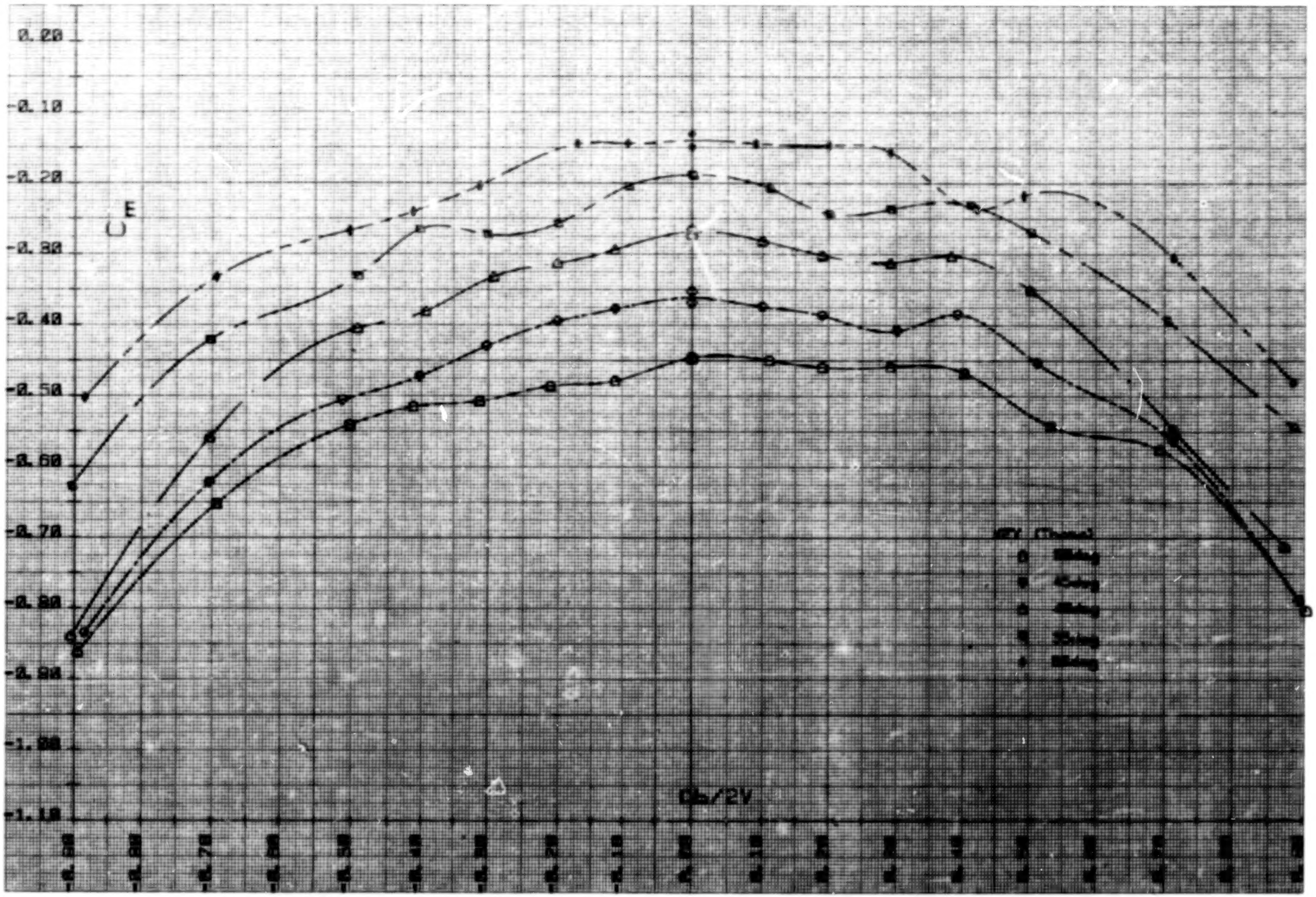
.)Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.8deg.

Figure 25.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r+22.5a.



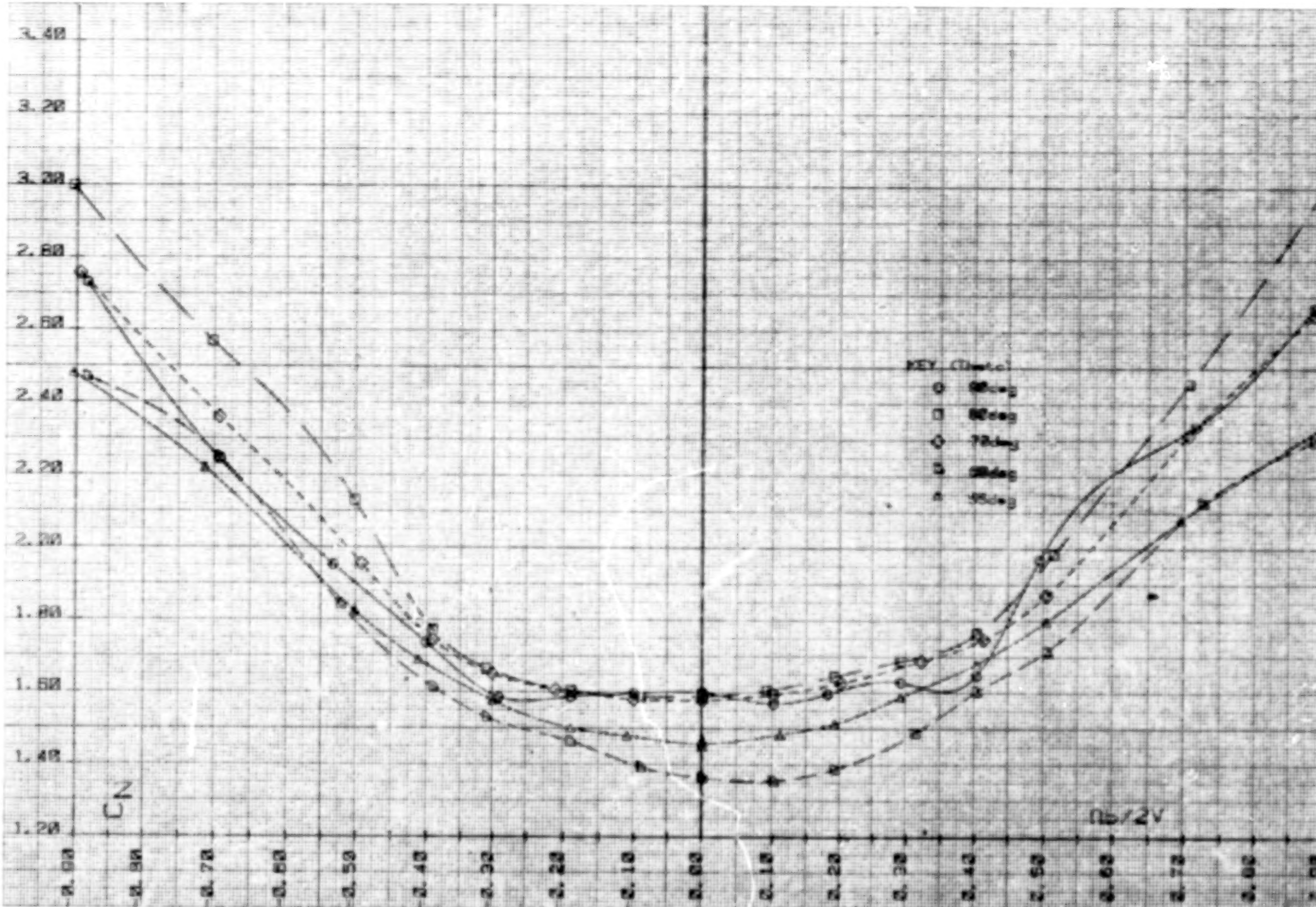
e.)Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.8deg.

Figure 25. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r+22.5a.



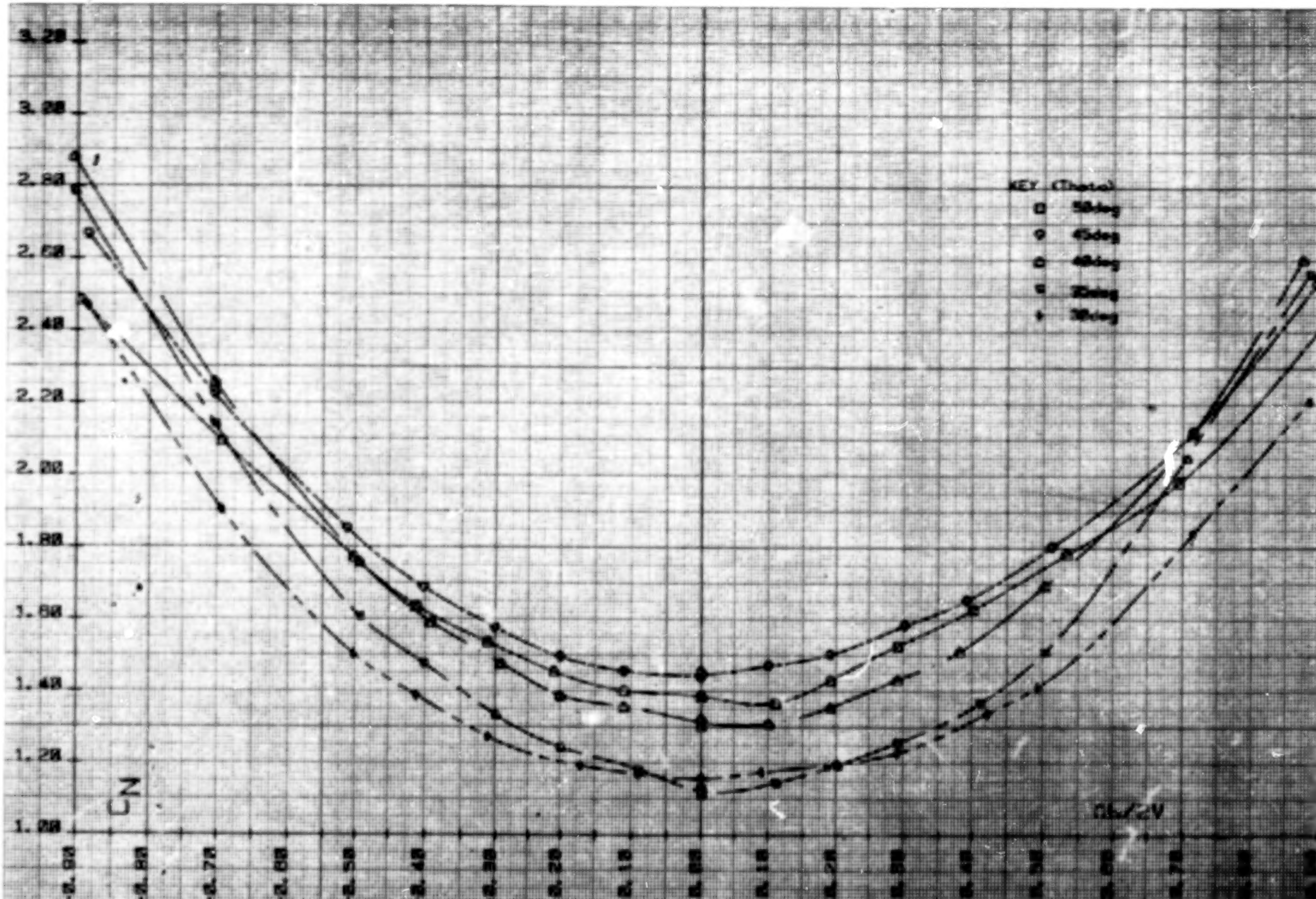
f.) Pitching-moment coefficient, Theta= 30 to 50deg: Phi=-0.2deg.

Figure 25.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r+22.5a.



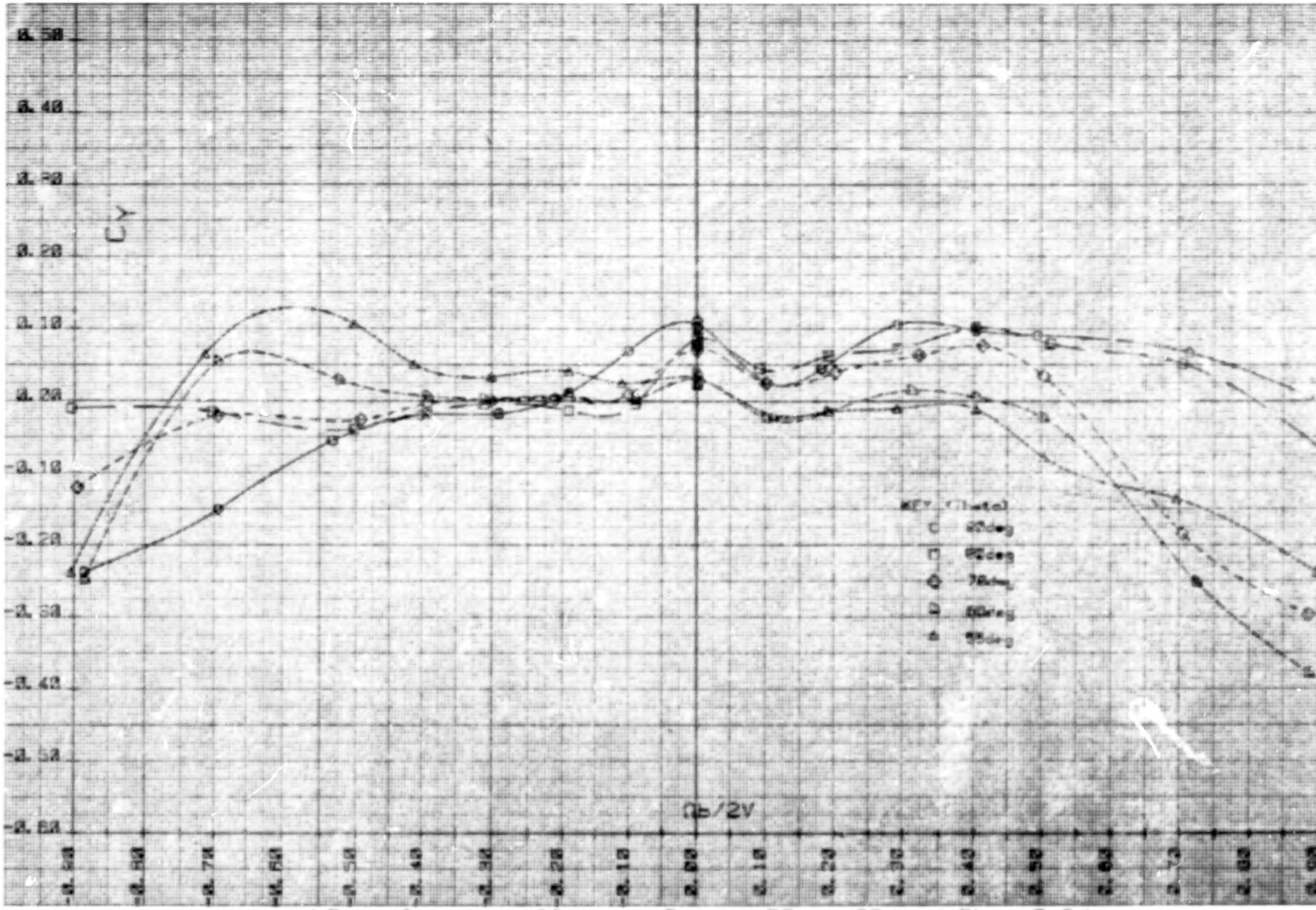
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 25.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r+22.5a.



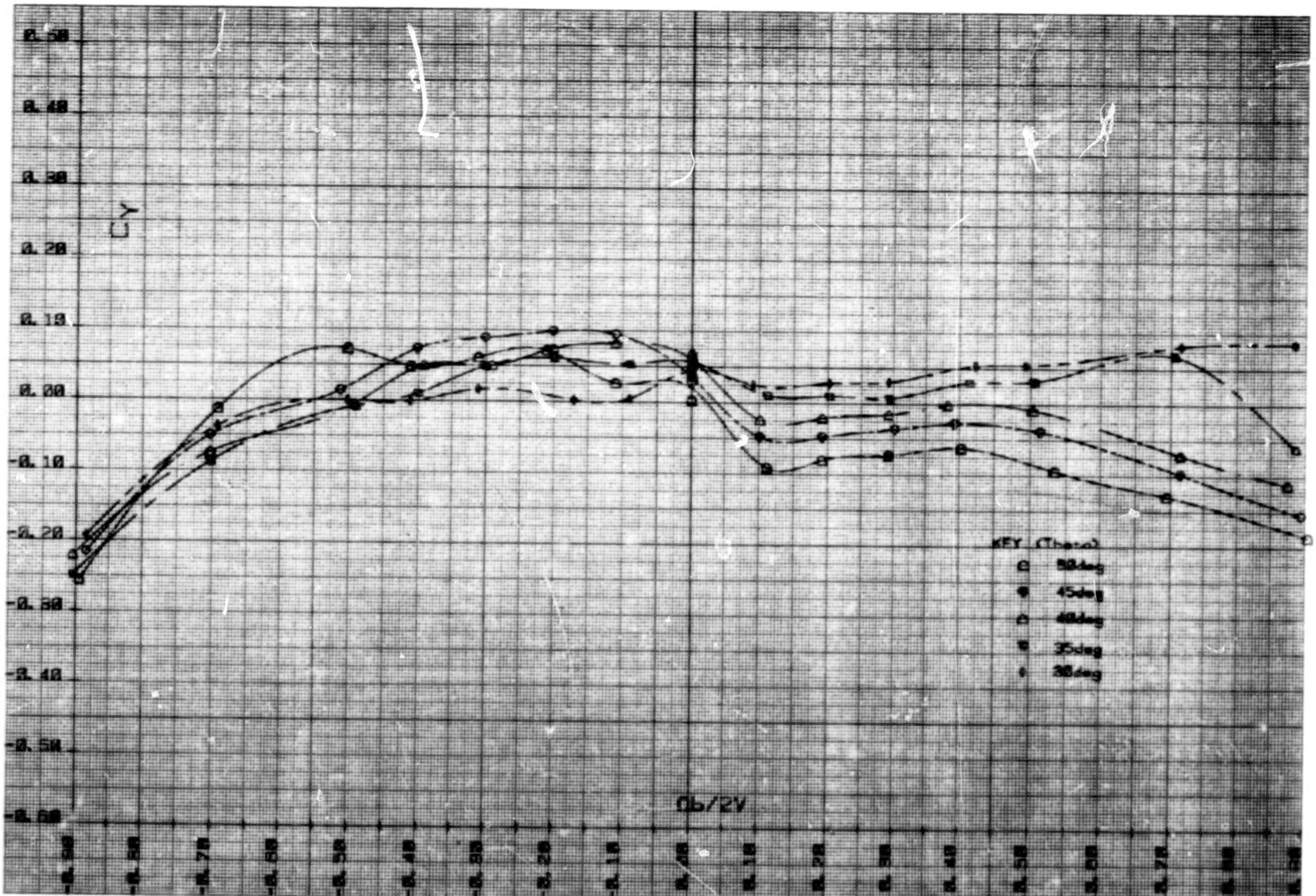
h.) Normal-force coefficient, Theta= 30 to 50deg, Phi=-0.2deg.

Figure 25.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r+22.5a.



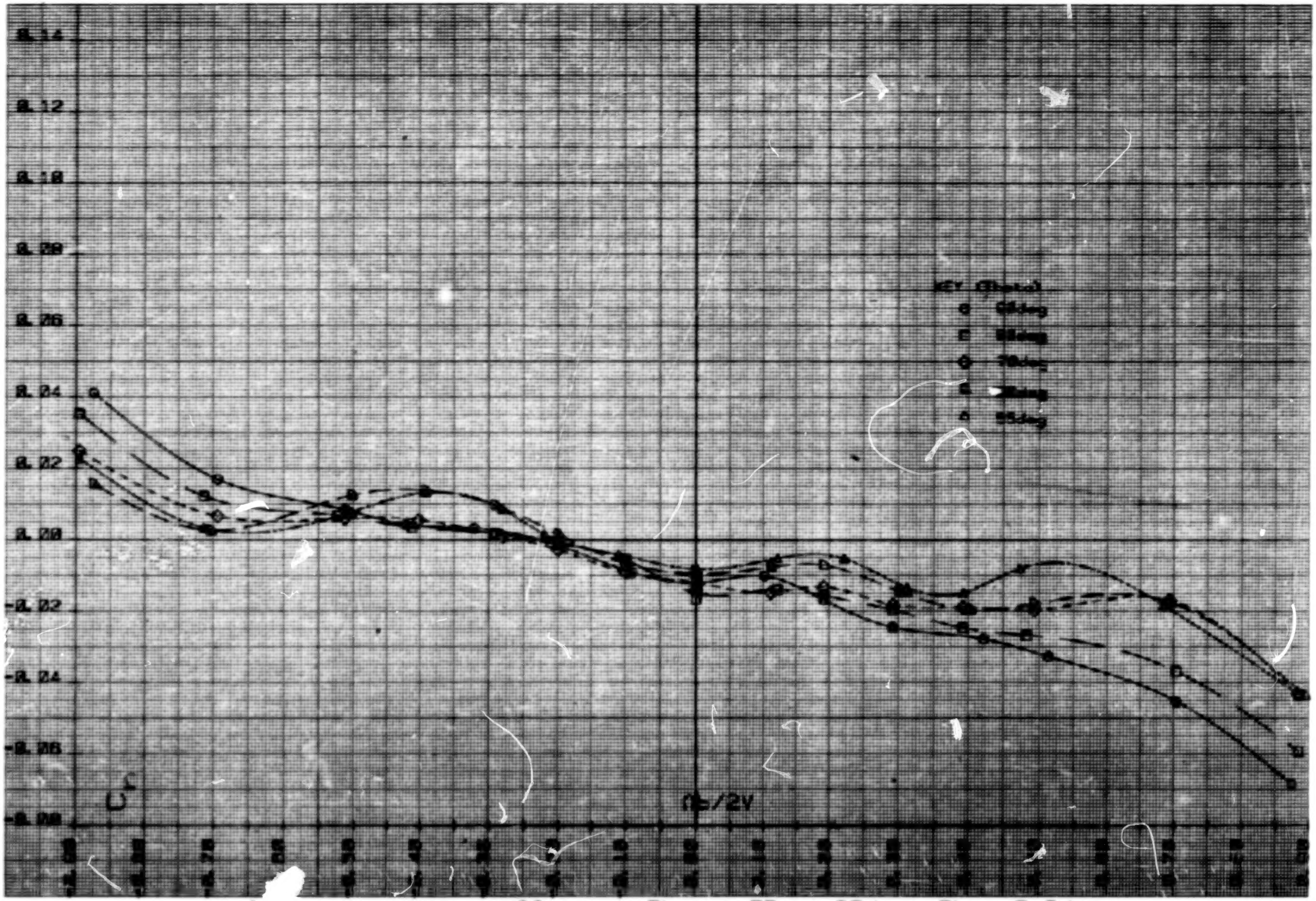
(.) Side-force coeff.cient, Theta= 55 to 90deg; Phi=-0.8deg.

Figure 25.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r+22.5a.



j.) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.8deg.

Figure 25. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-25r+22.5a.



a.) ... wing-moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 26.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-22.5a.

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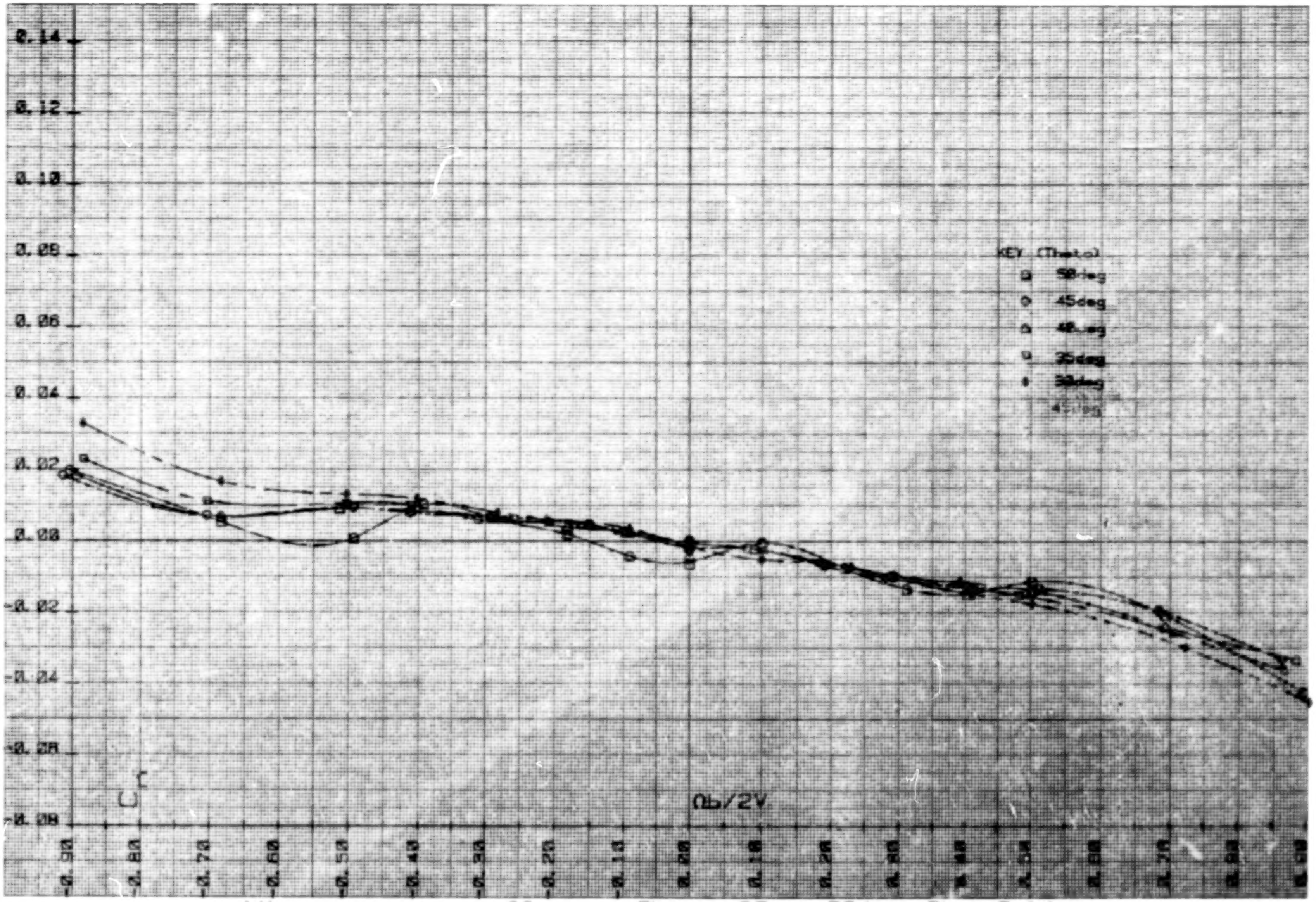
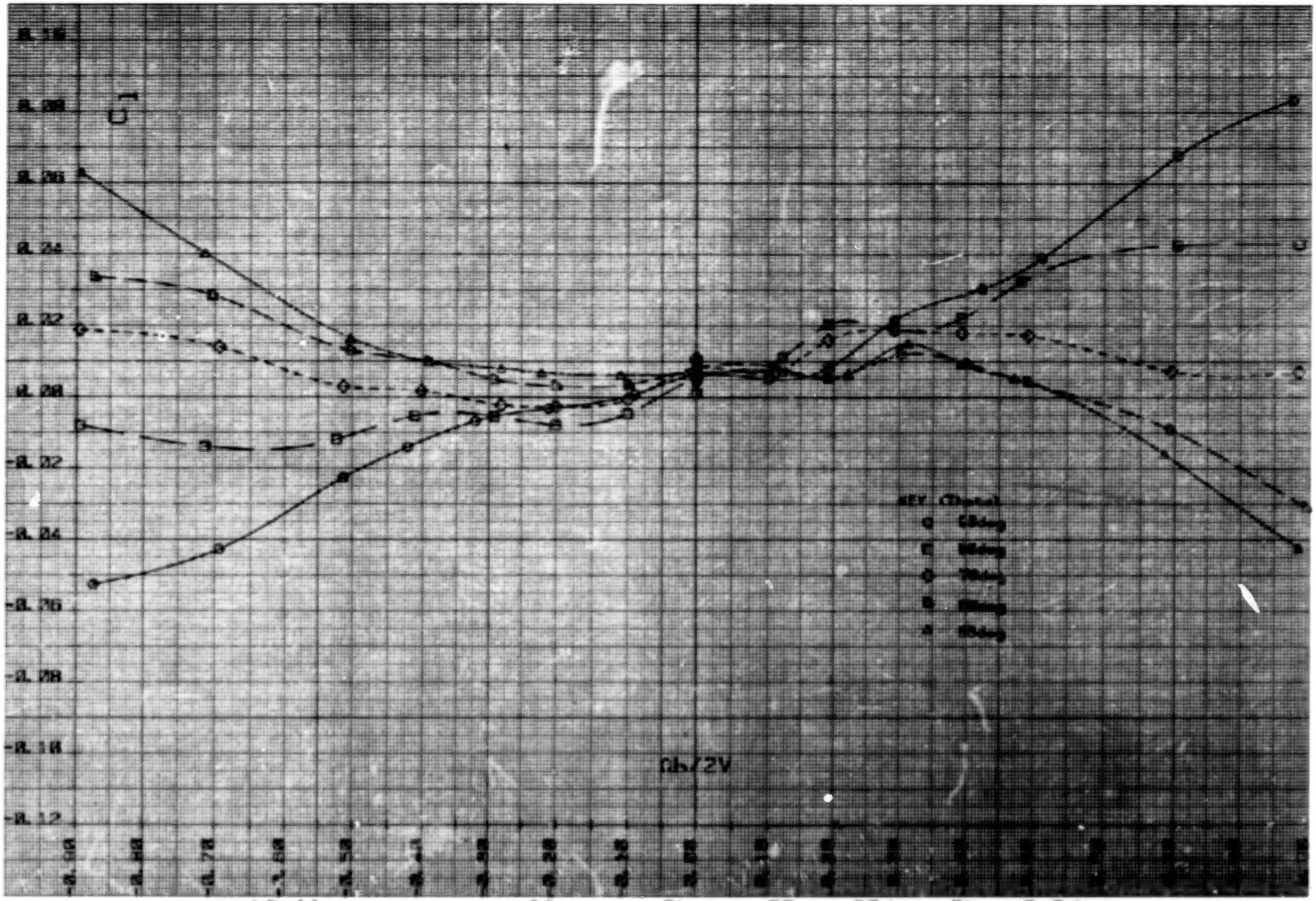


(b) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

Figure 26.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-22.5a.



c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 26. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-22.5a.

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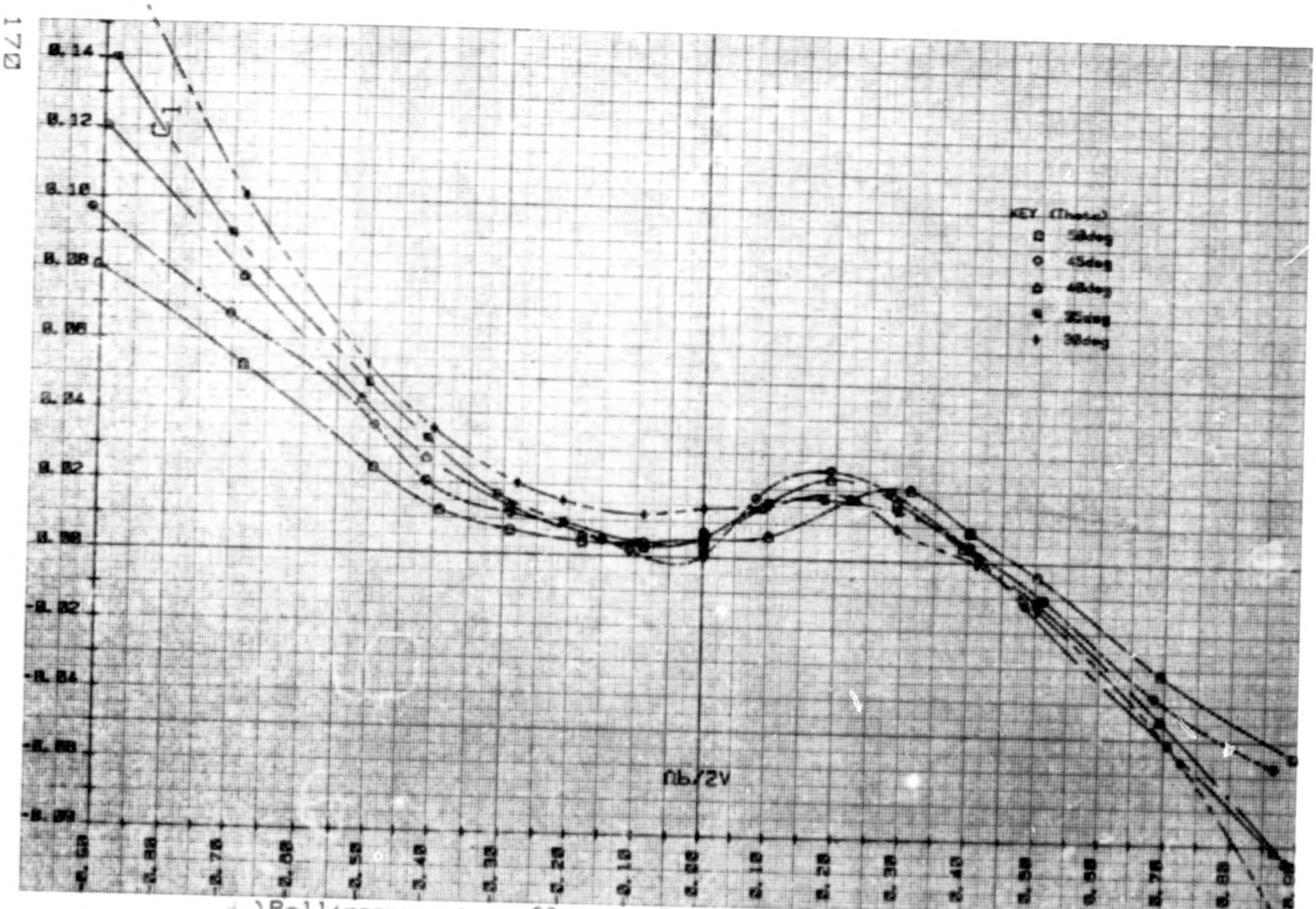
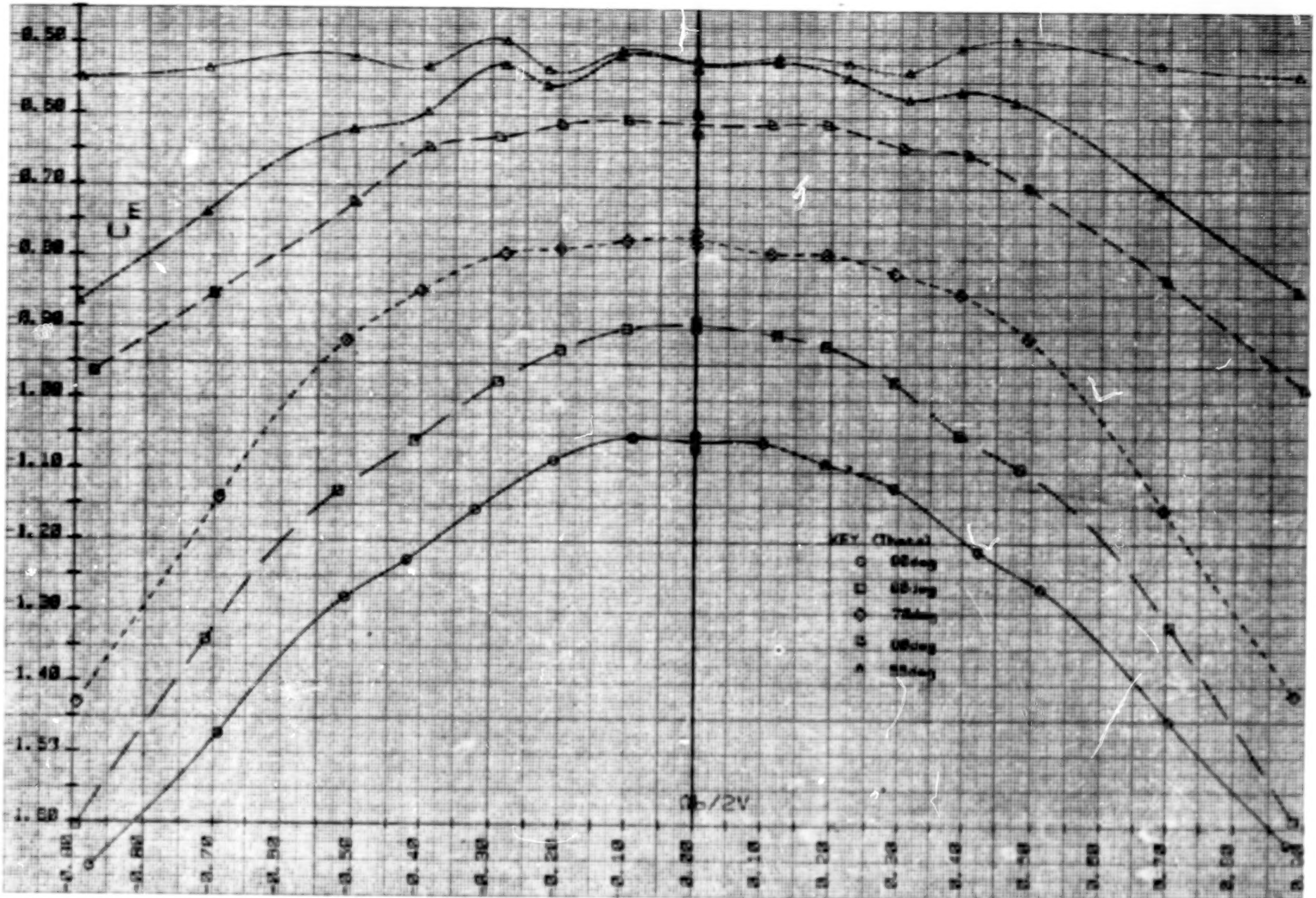


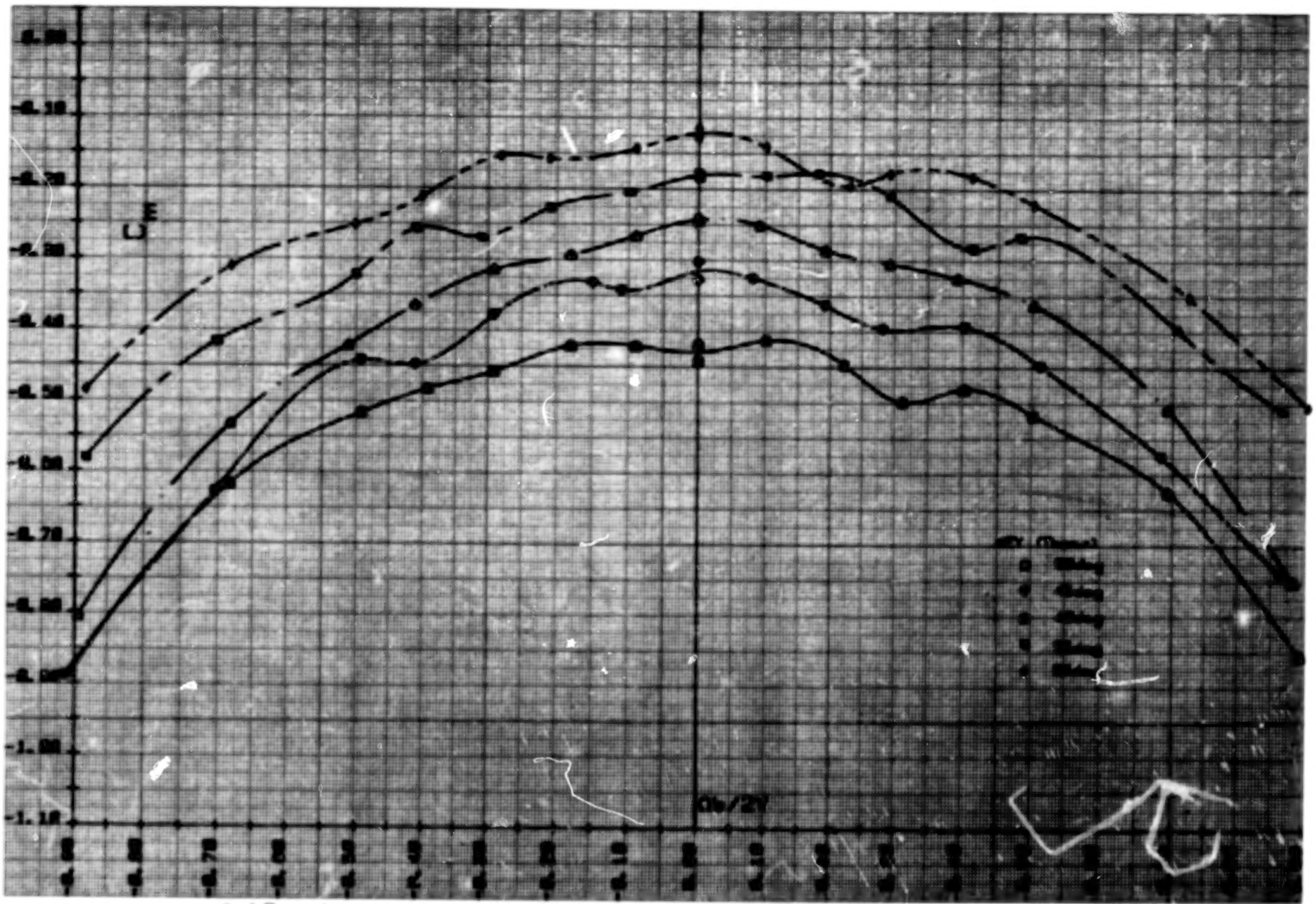
d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

Figure 26.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-22.5a.



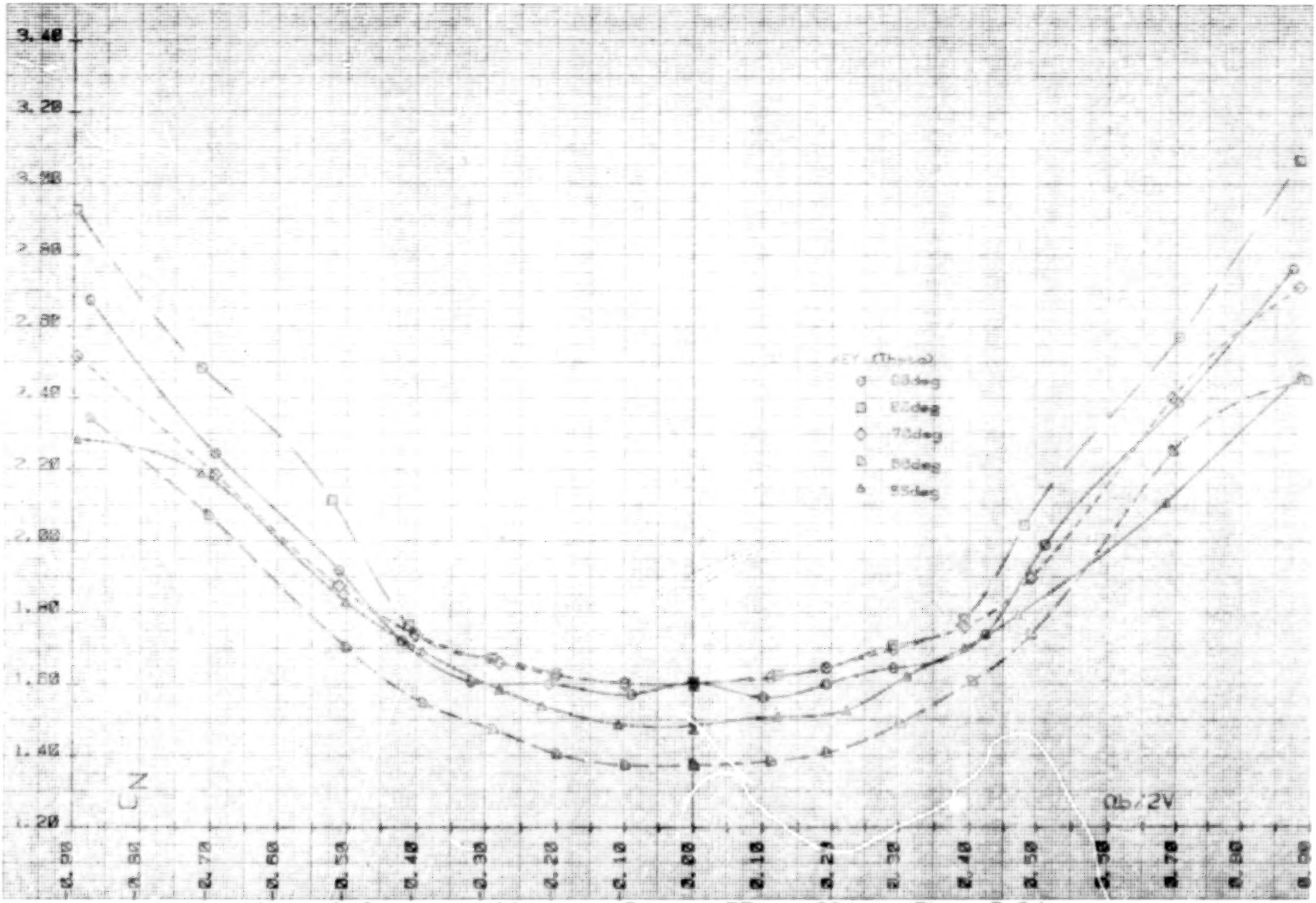
a.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

Figure 26.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-22.5a.



(f.) Pitching-moment coefficient. Theta= 30 to 50deg; Phi=-0.1deg.

Figure 26.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-22.5u.



g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 26. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-22.5o.

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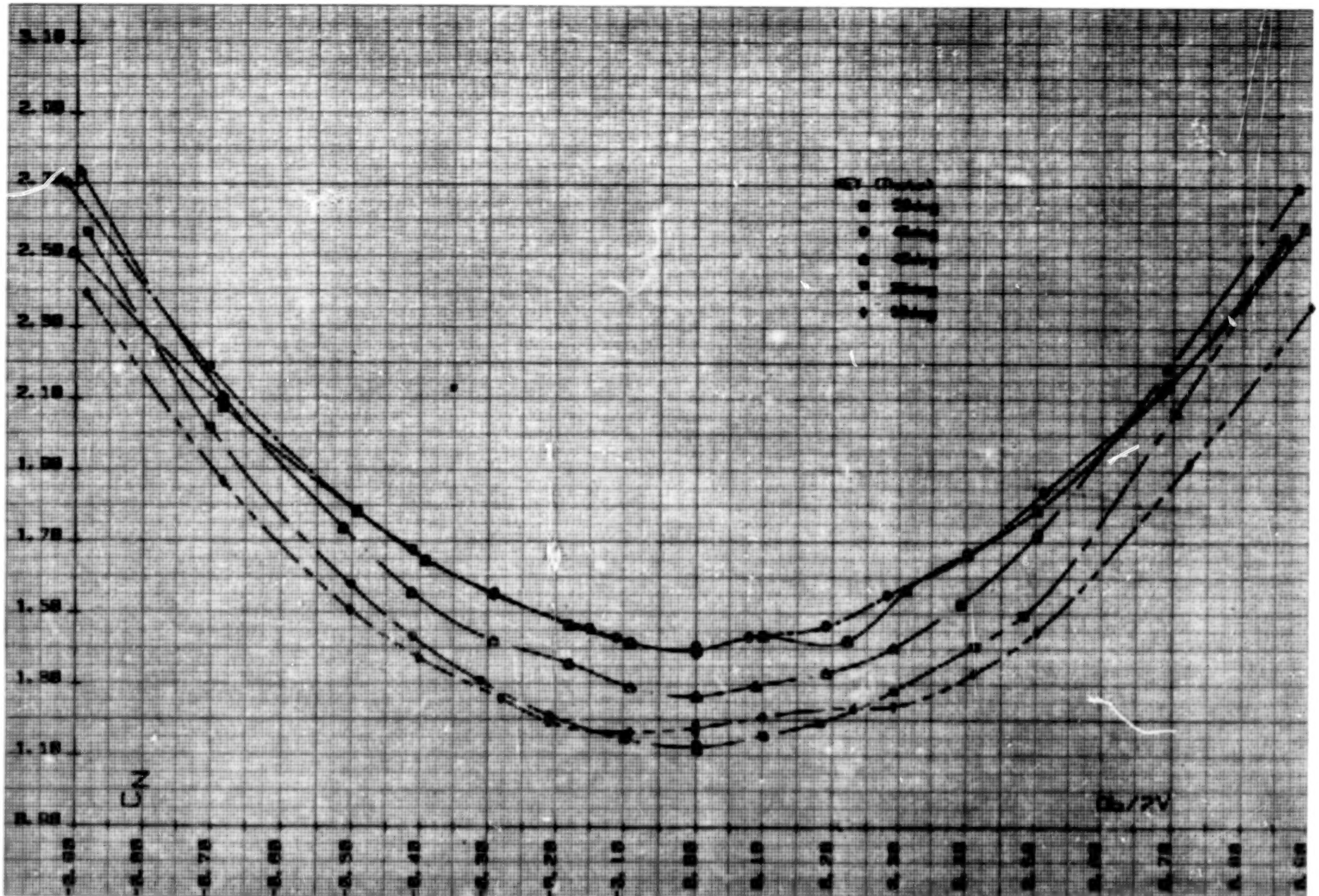
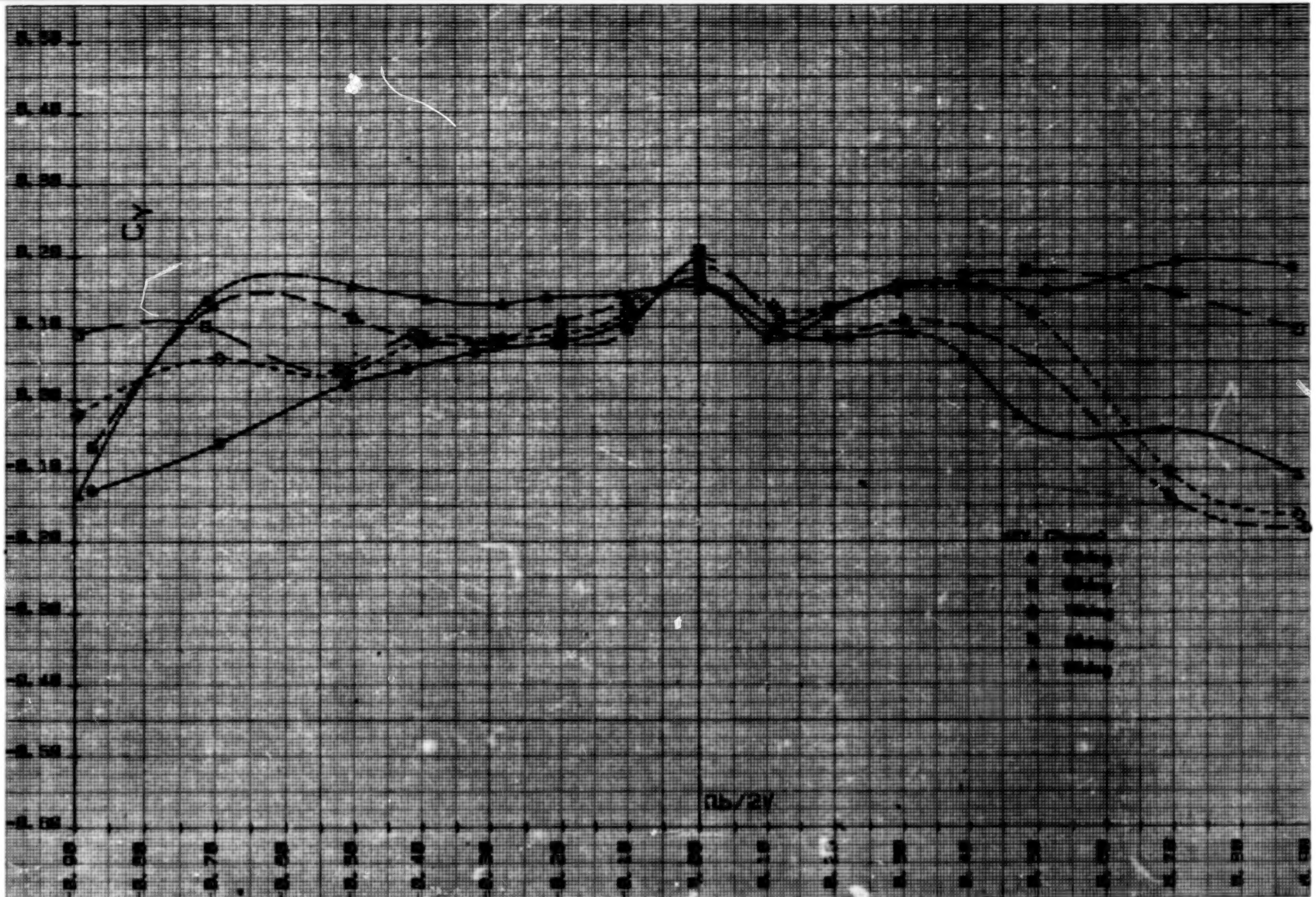


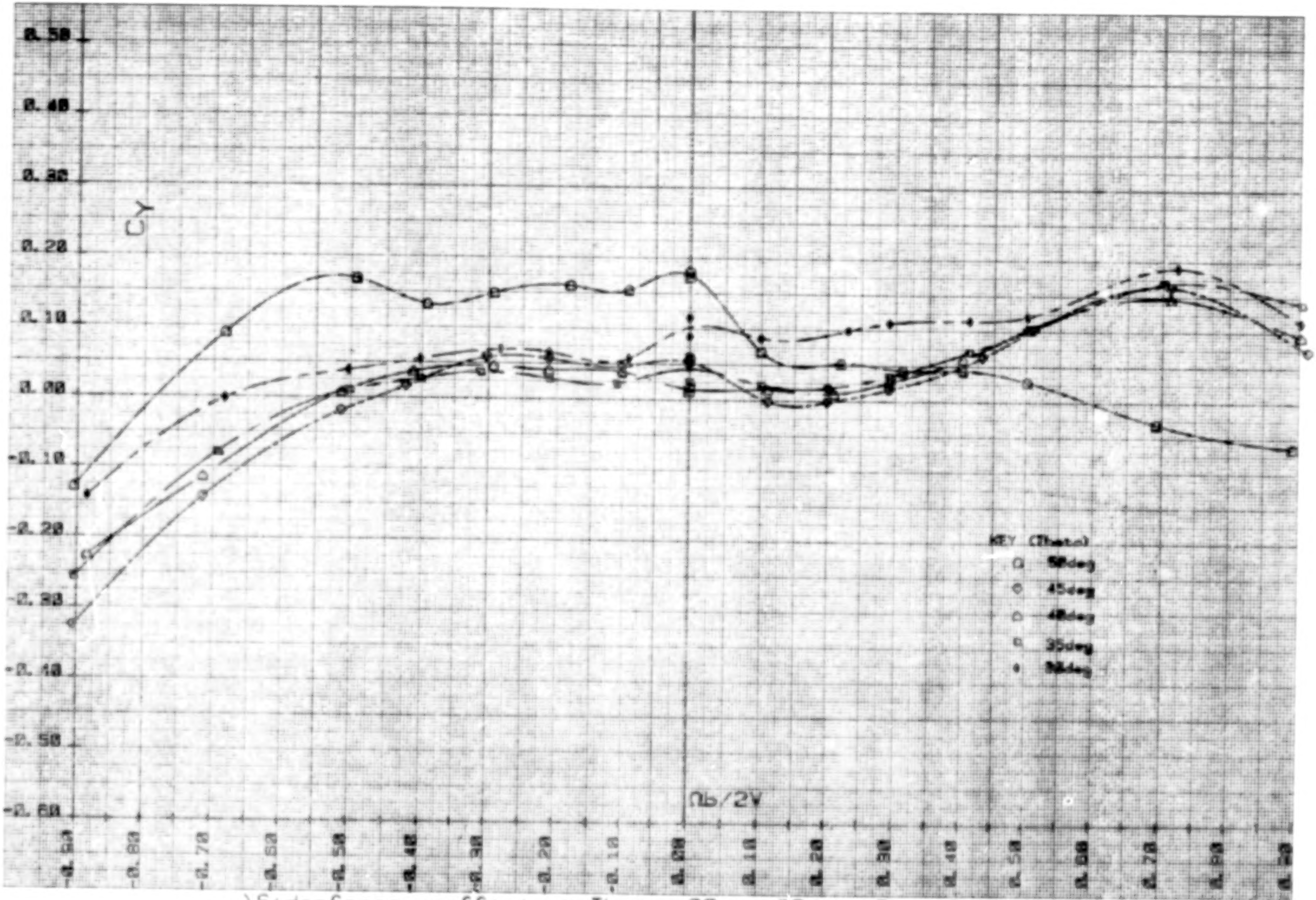
h.)Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

Figure 26.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-22.5a.



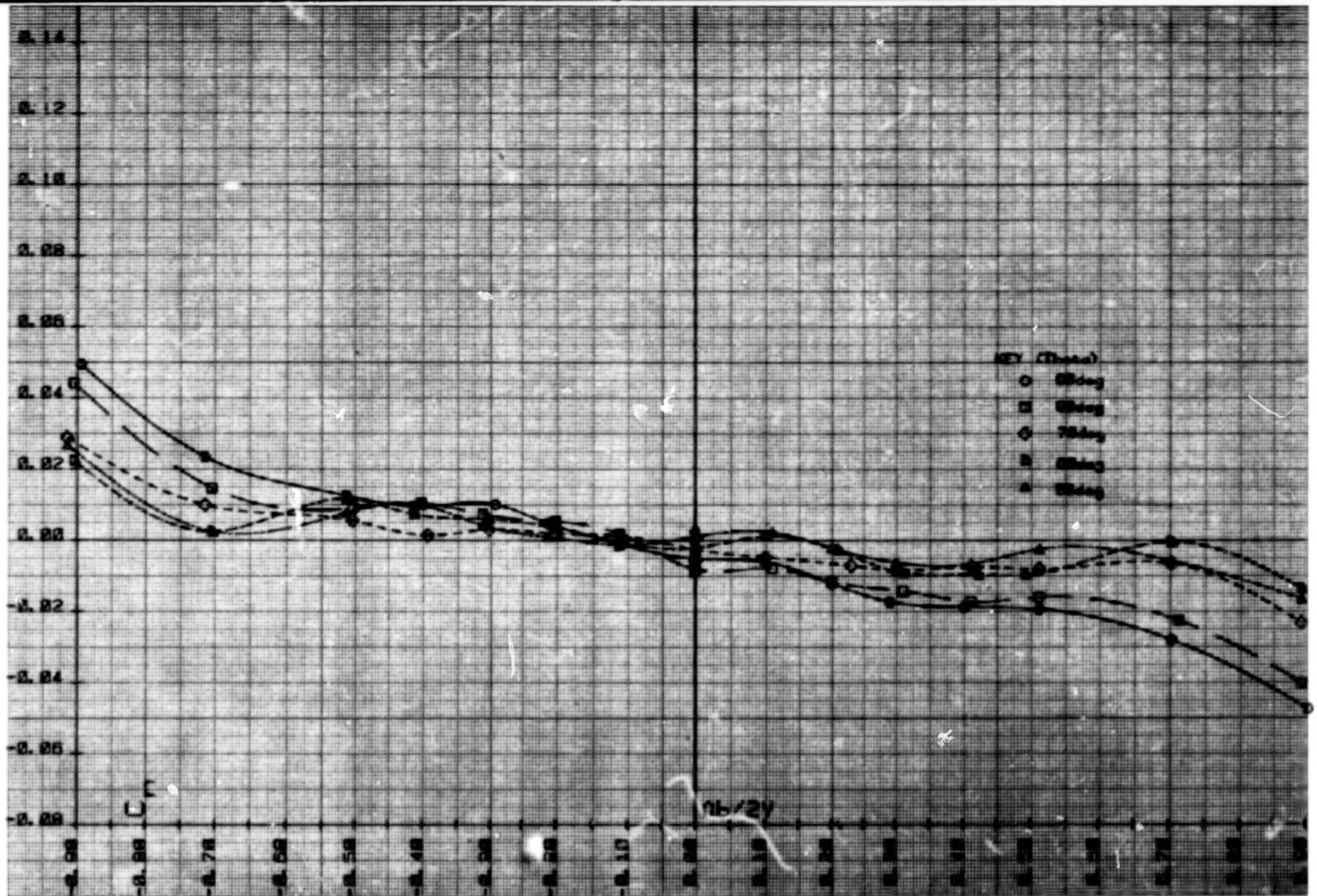
(.)Side-force coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

Figure 26. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-22.5a.



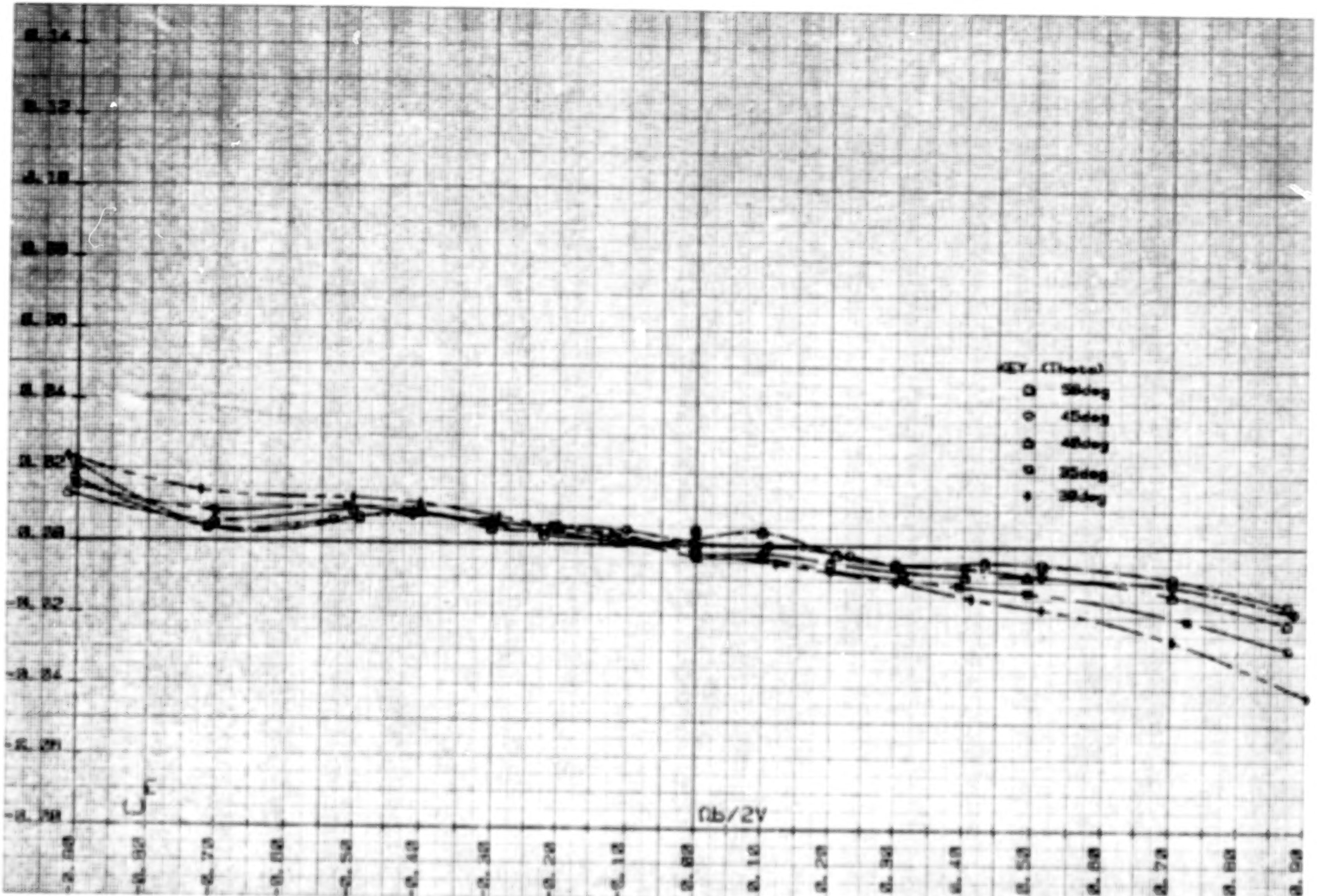
.) Side-force coefficient, Theta= 30 to 50deg: Phi=-0.1deg.

Figure 26. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V-25e-22.5a.



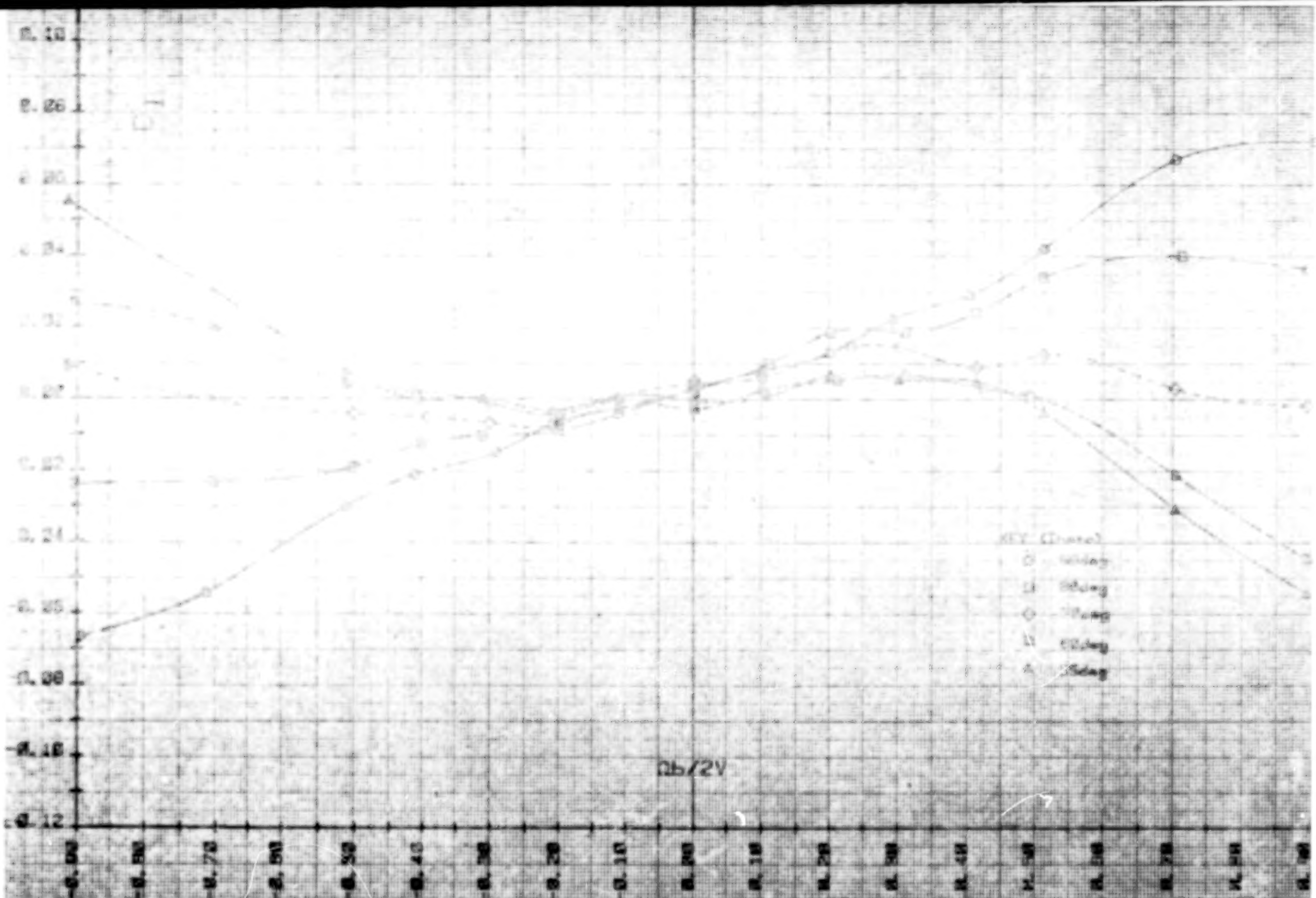
a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 27.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+15e.



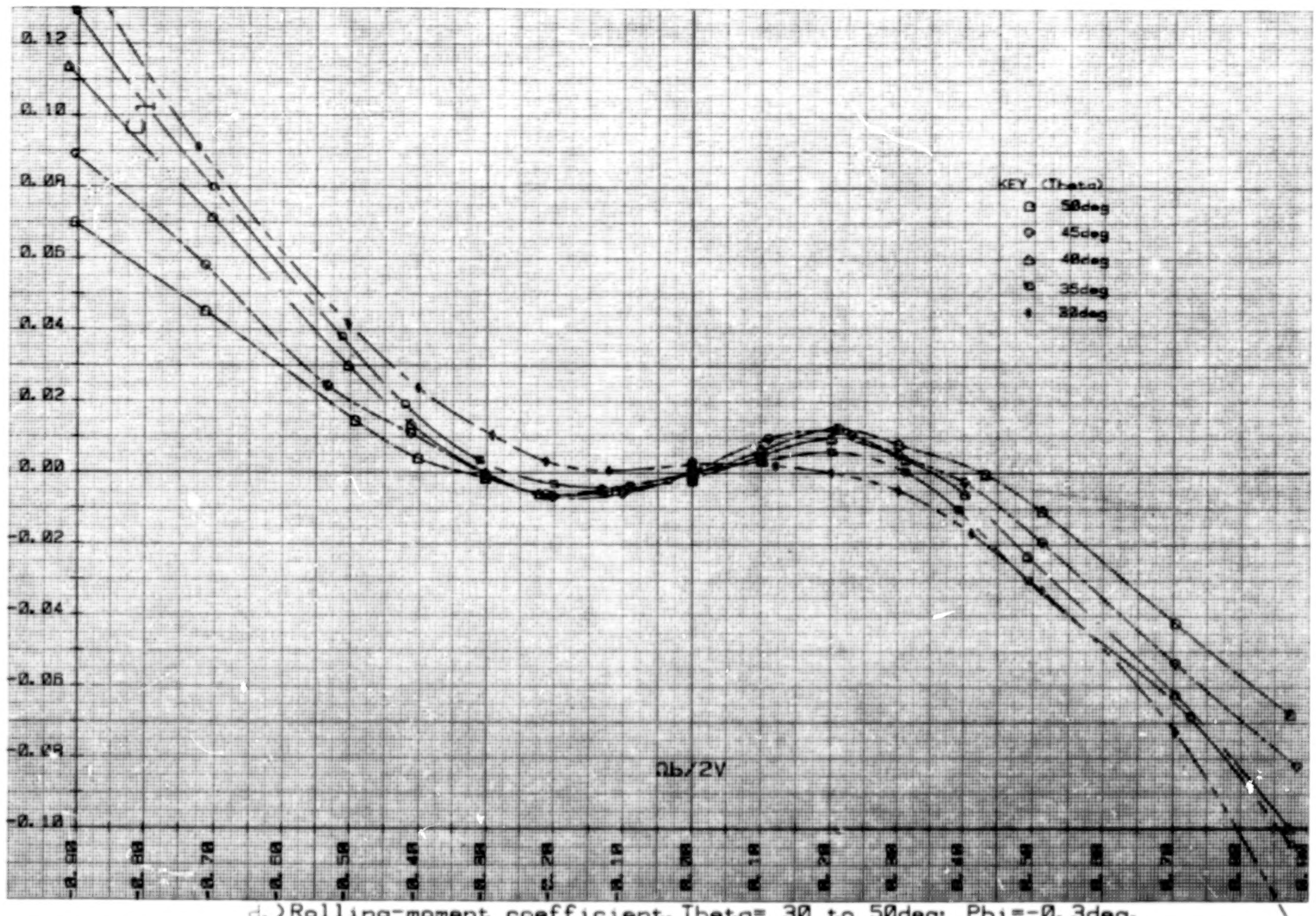
(c) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 27.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+15e.



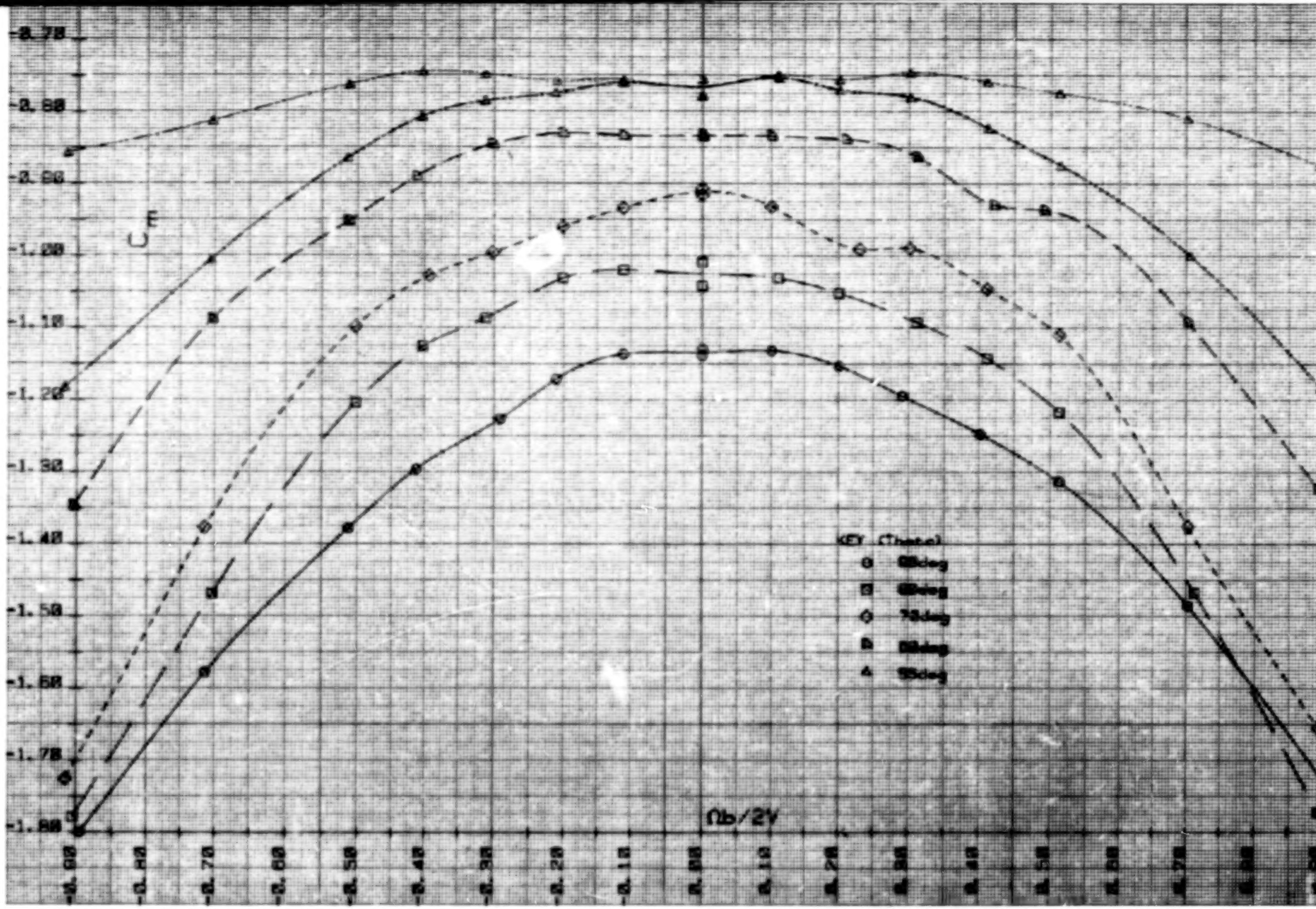
c.) Rolling-moment coefficient. Theta= 55 to 90deg; Phi=-0.3deg.

Figure 27. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+15e.



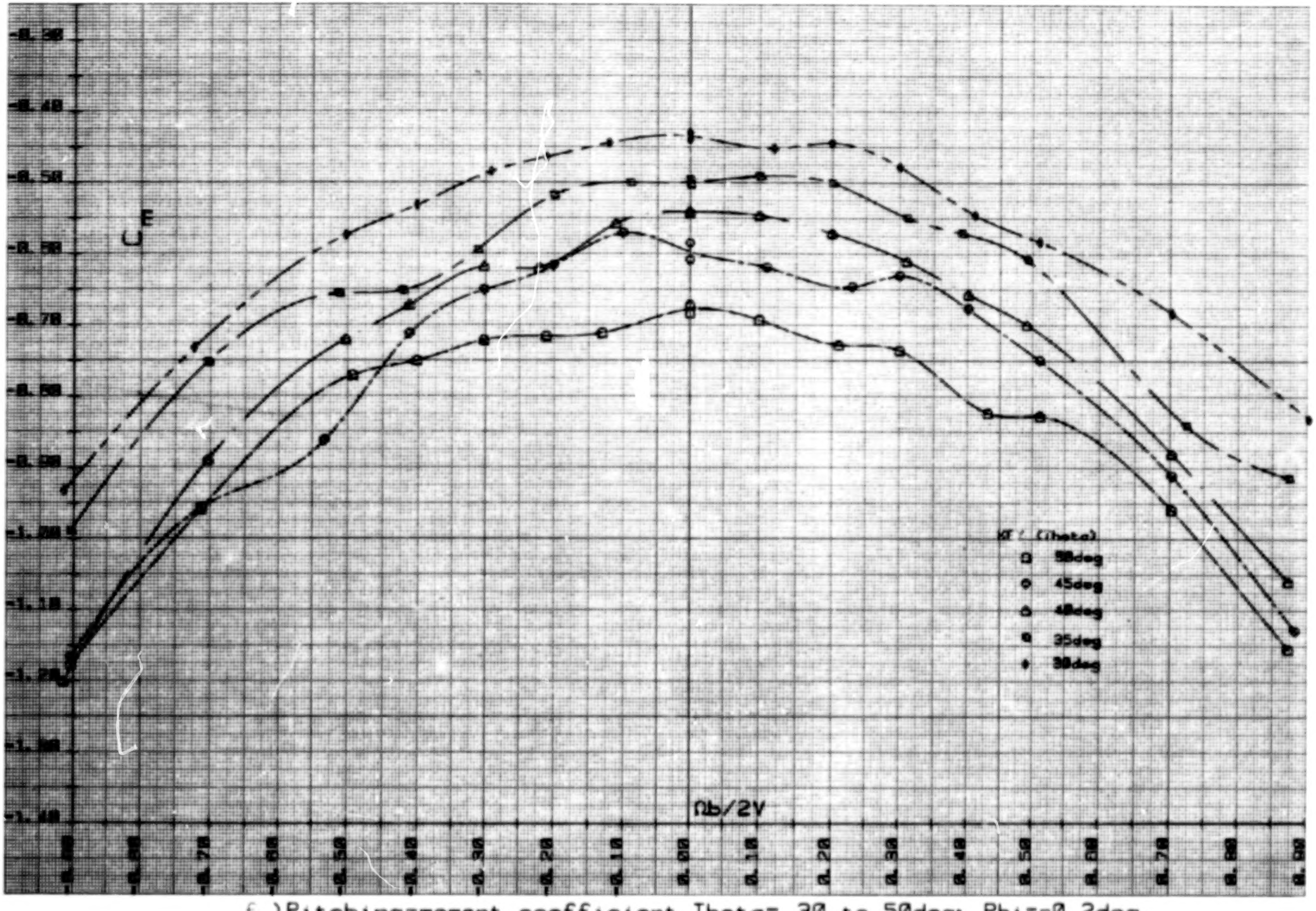
d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 27.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+15e.



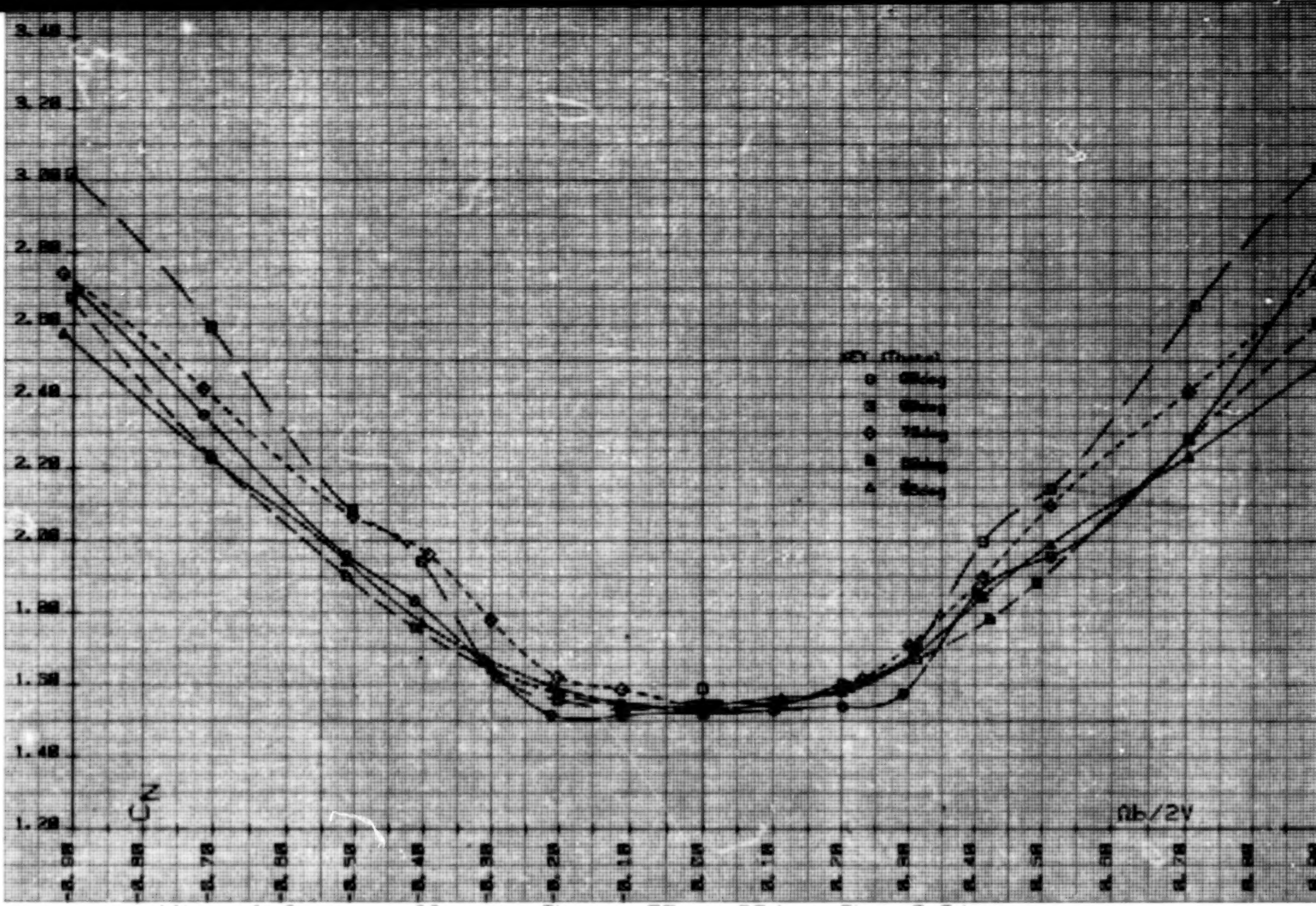
a.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.0deg.

Figure 27.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+15e.



f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 27. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic



g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.0deg.

Figure 27.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+15e.

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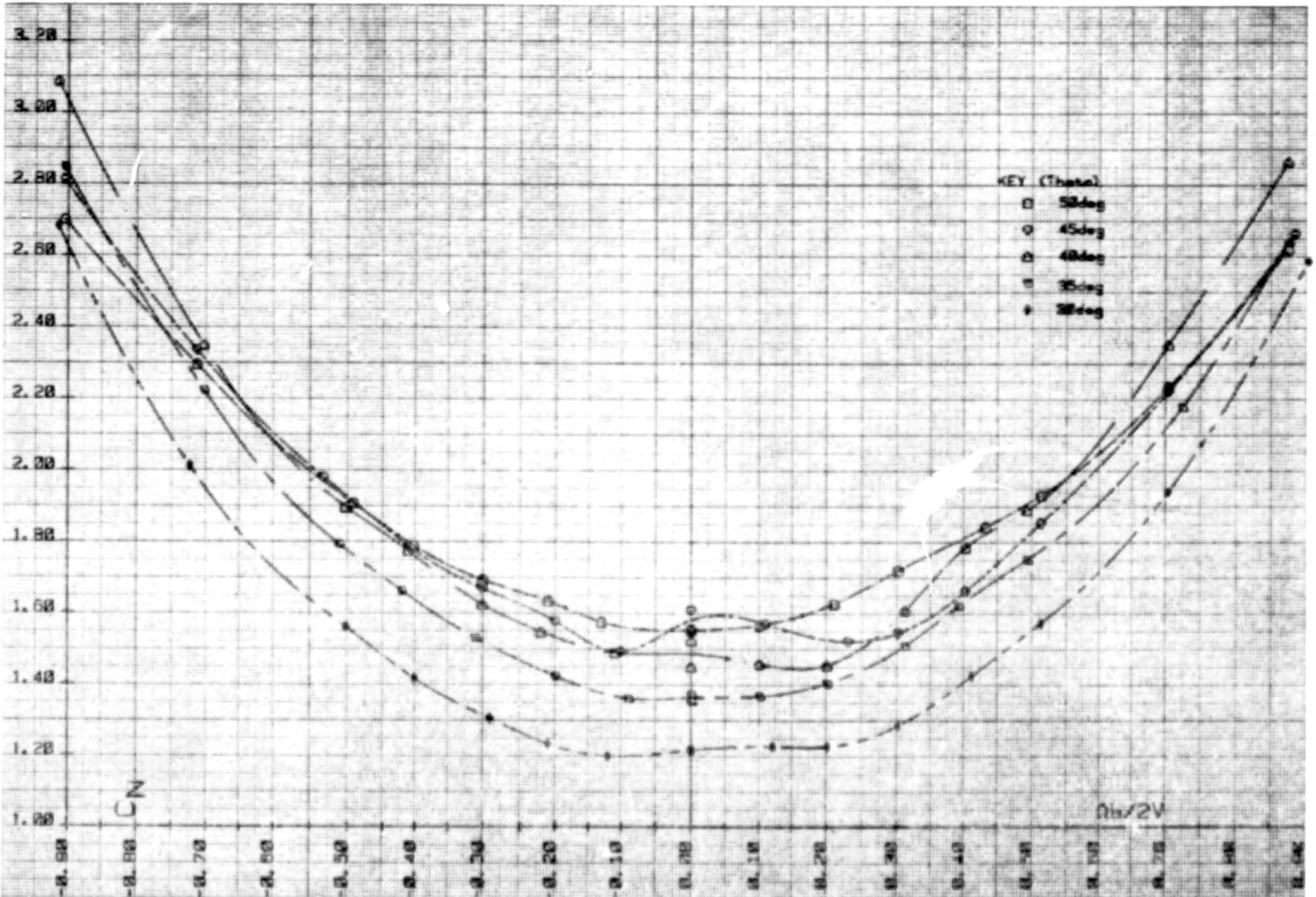
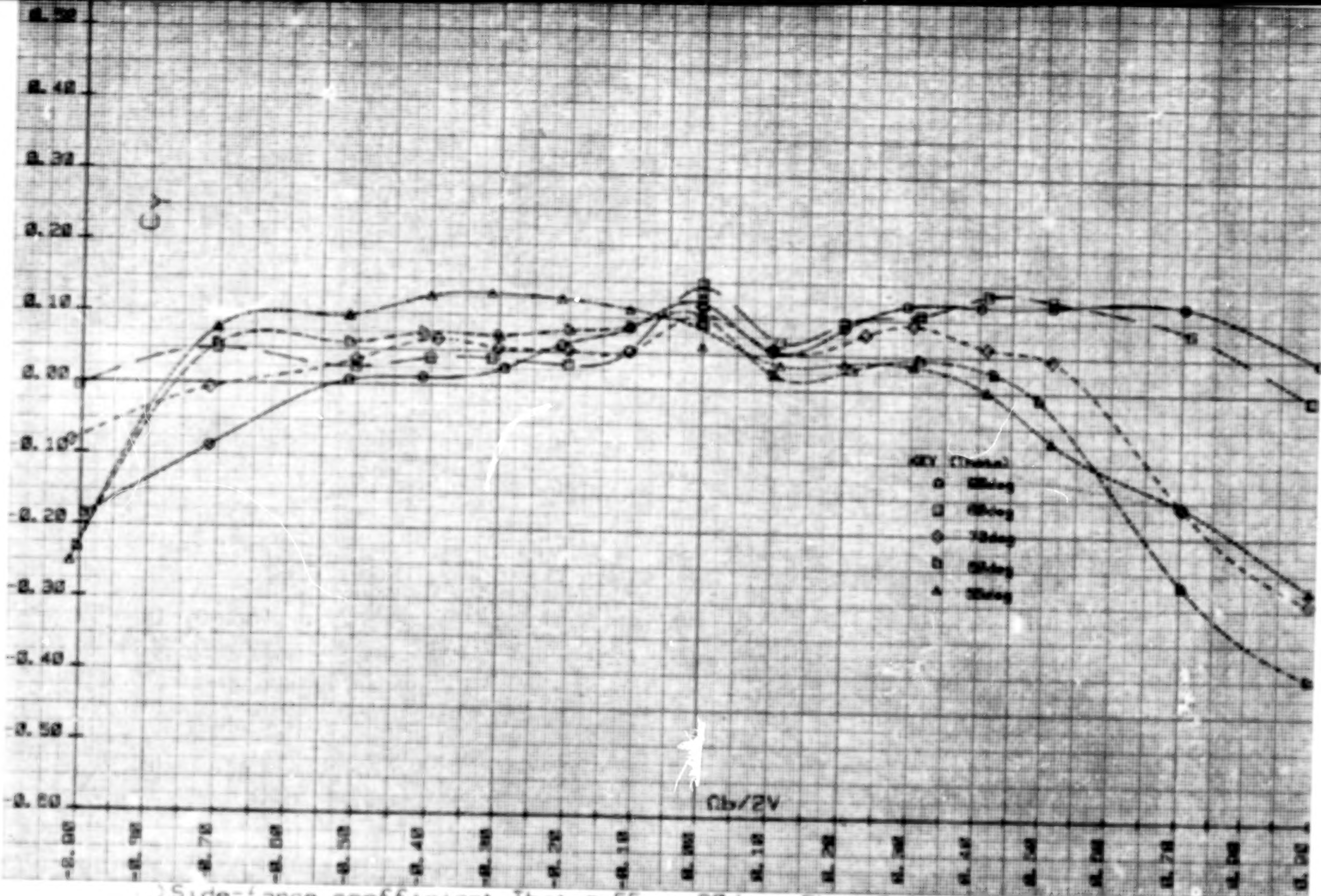


(h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 27.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+15s.



(.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 27.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3V+15e.

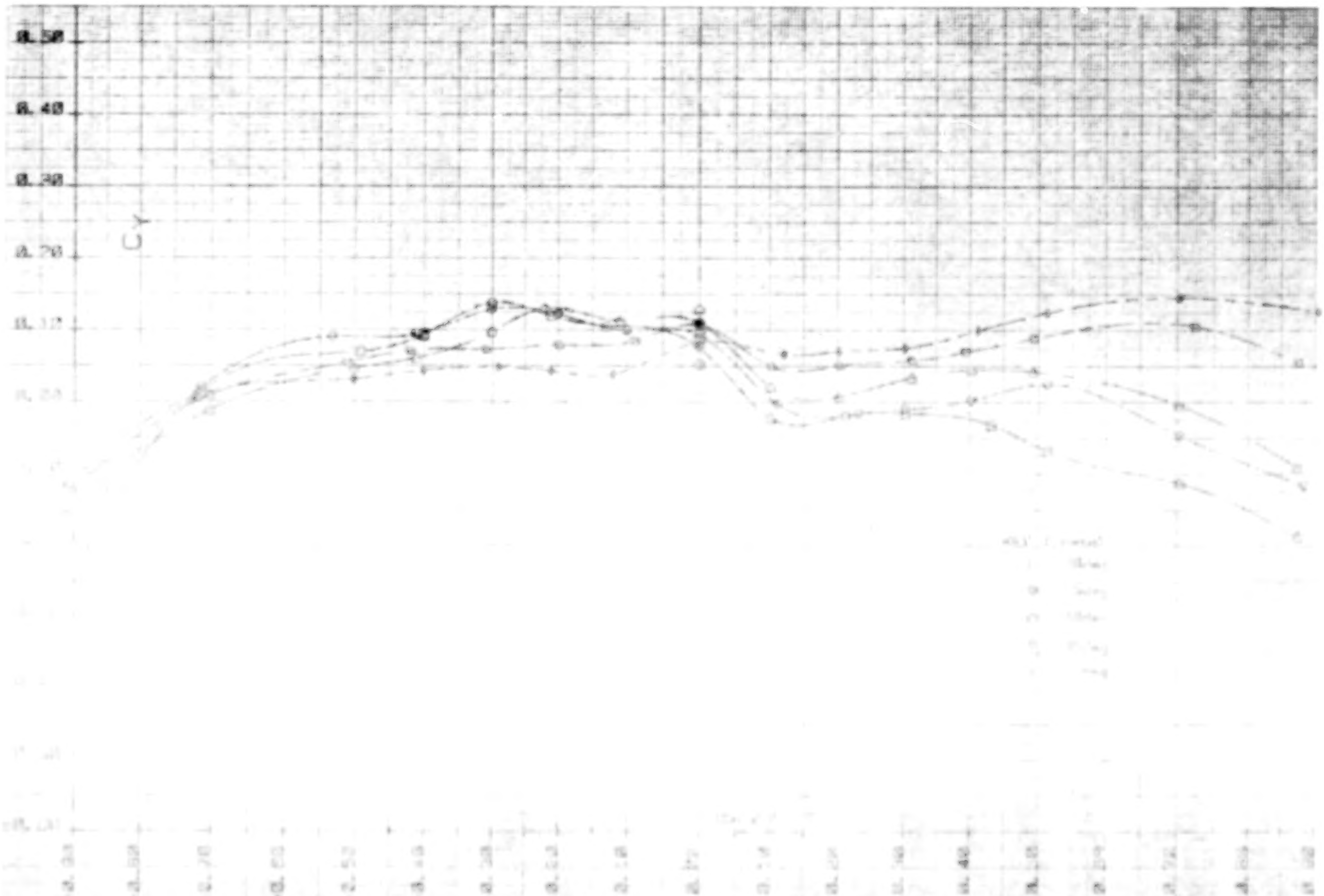
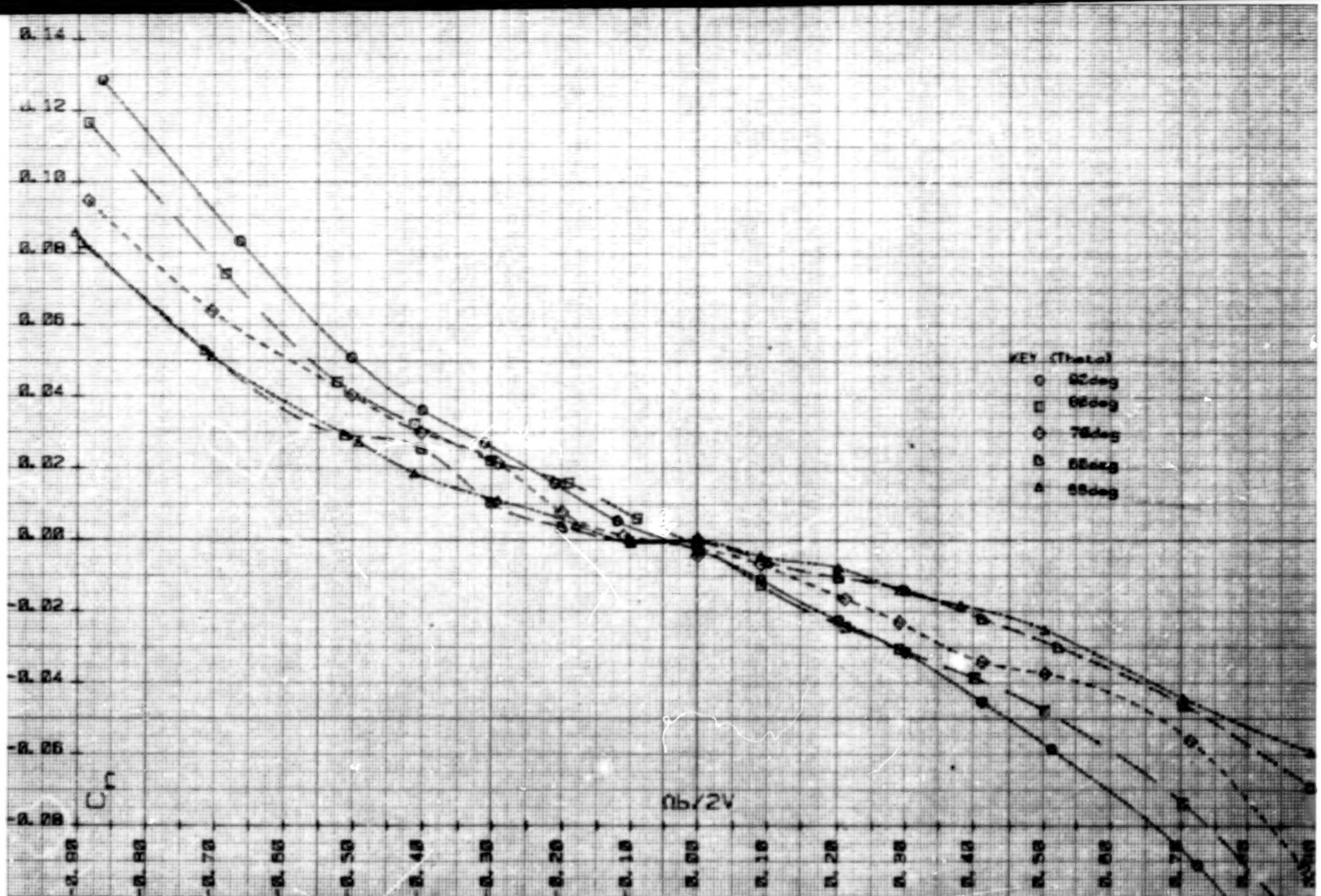


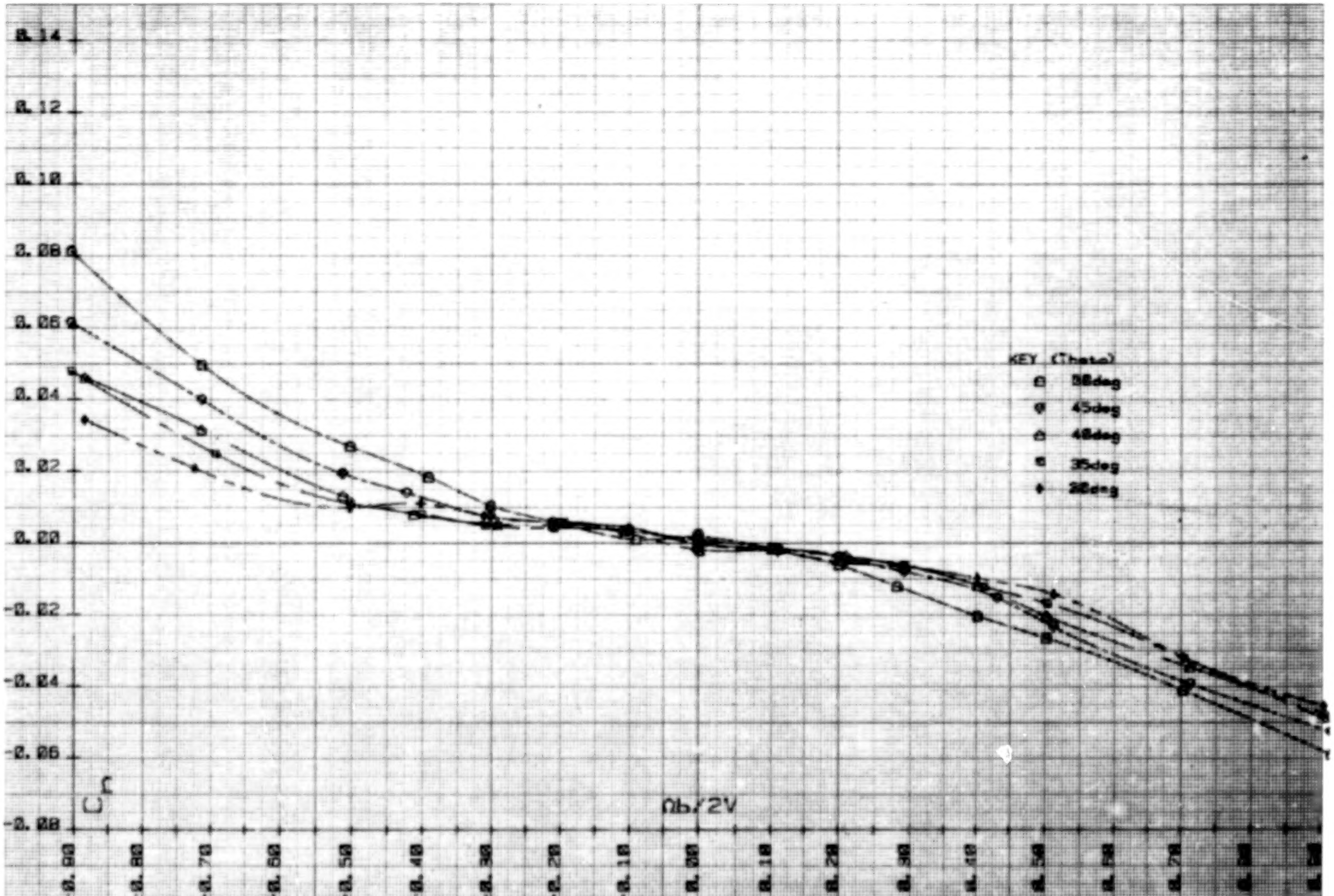
Figure 27 ... of rotation rate and pitch and roll attitude angles on aerodynamic ... for configuration BW1H3V+15.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.6deg.

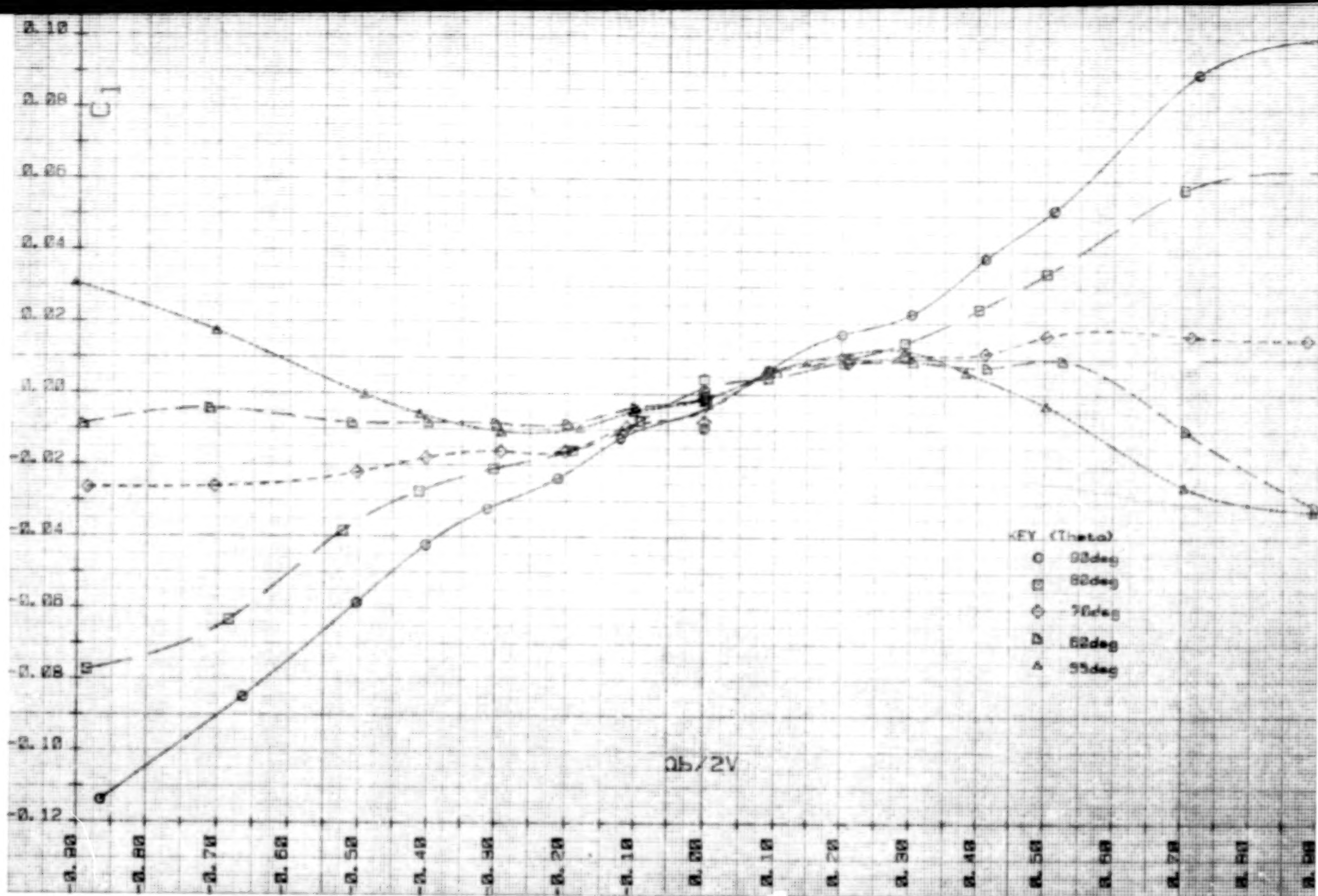
Figure 28.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V.

187



(.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

Figure 28.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V.



c.) Rolling-moment coefficient. Theta= 55 to 90deg; Phi=-0.6deg.

Figure 28. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V.

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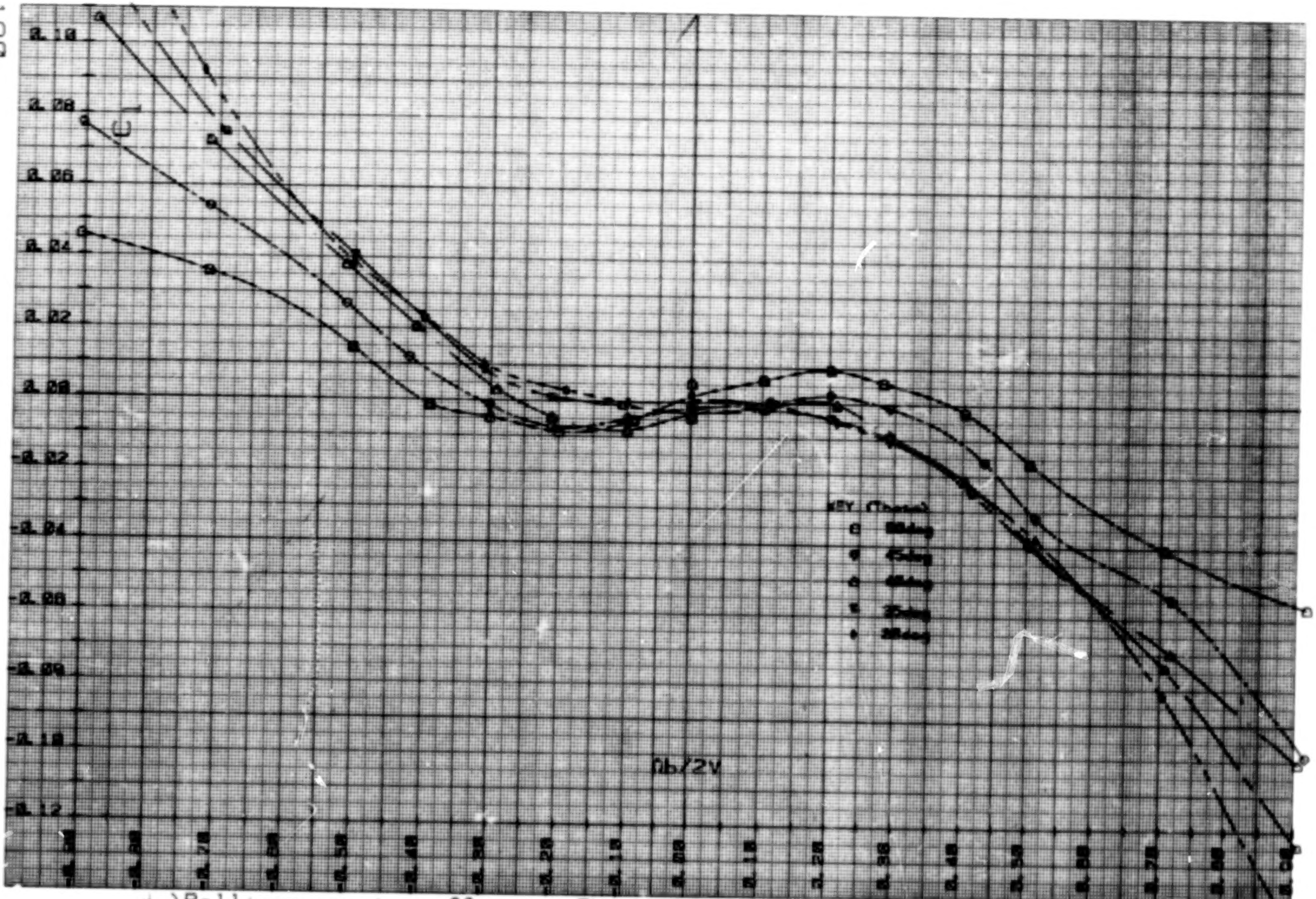
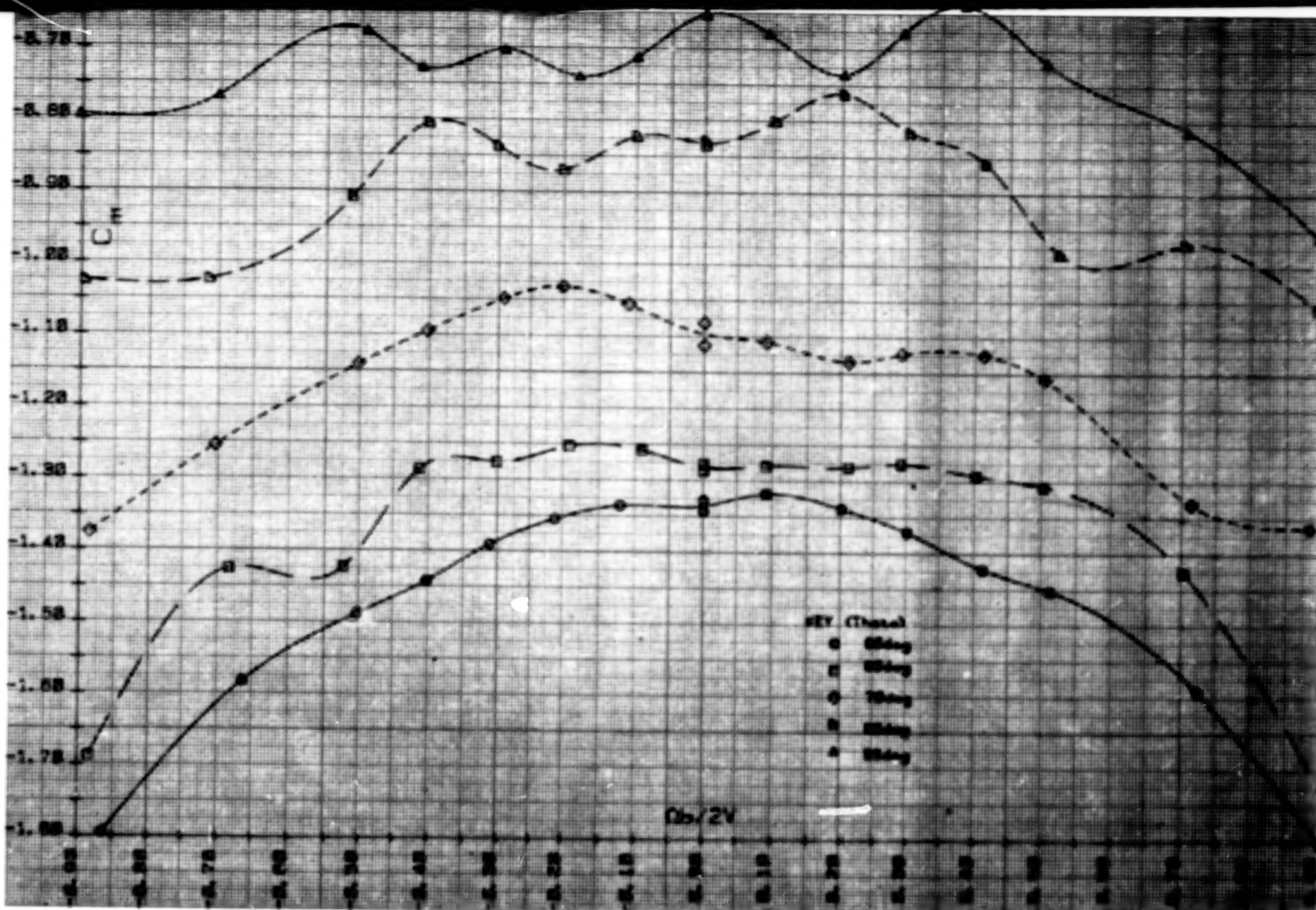


d.)Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

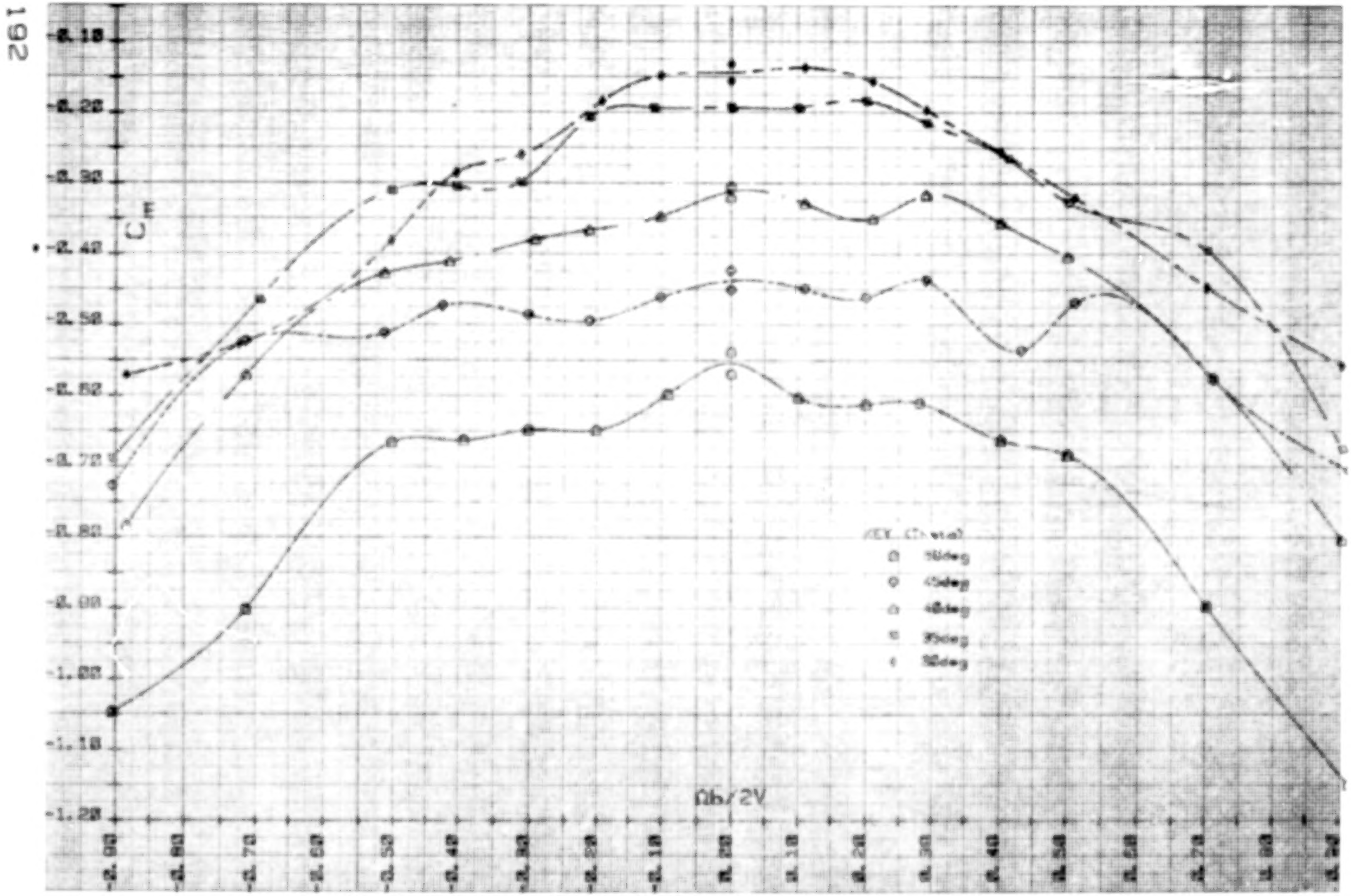
Figure 28. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic



a.) Pitching-moment coefficient. Theta= 55 to 90deg; Phi=-0.1deg.

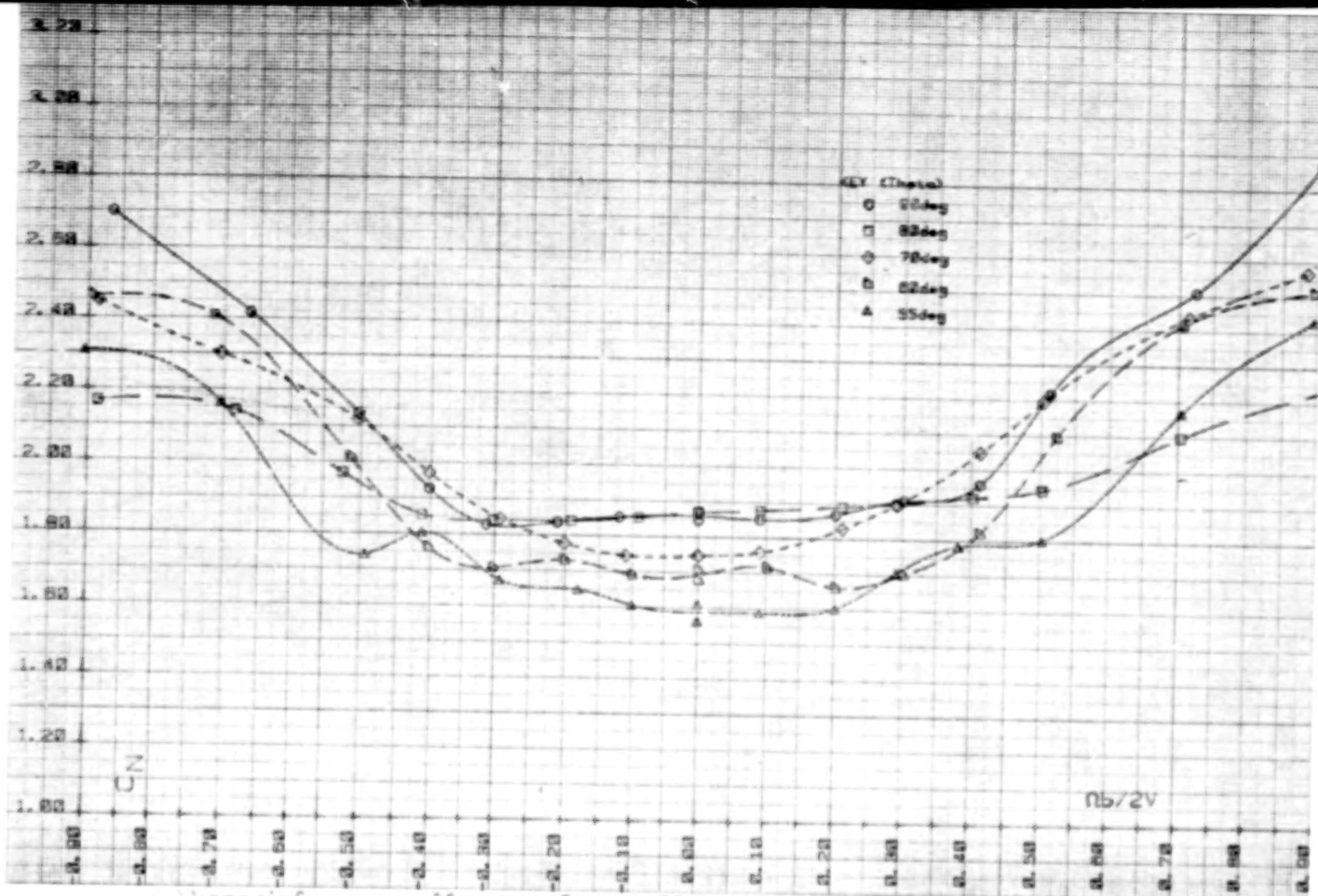
Figure 28.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V.

192



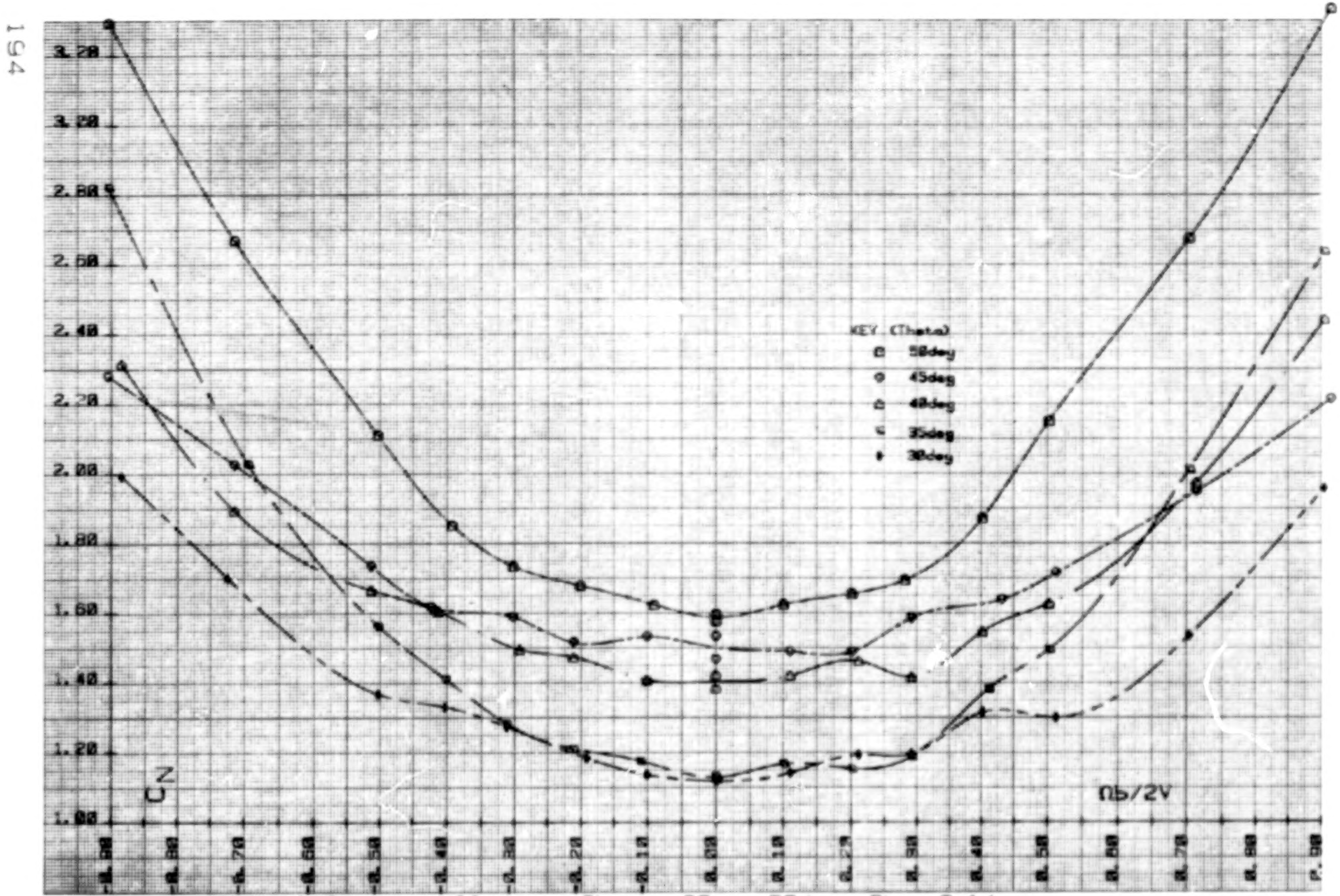
(f.) Pitching-moment coefficient. Theta= 30 to 50deg; Phi=-0.2deg.

Figure 28.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BX1H5V.



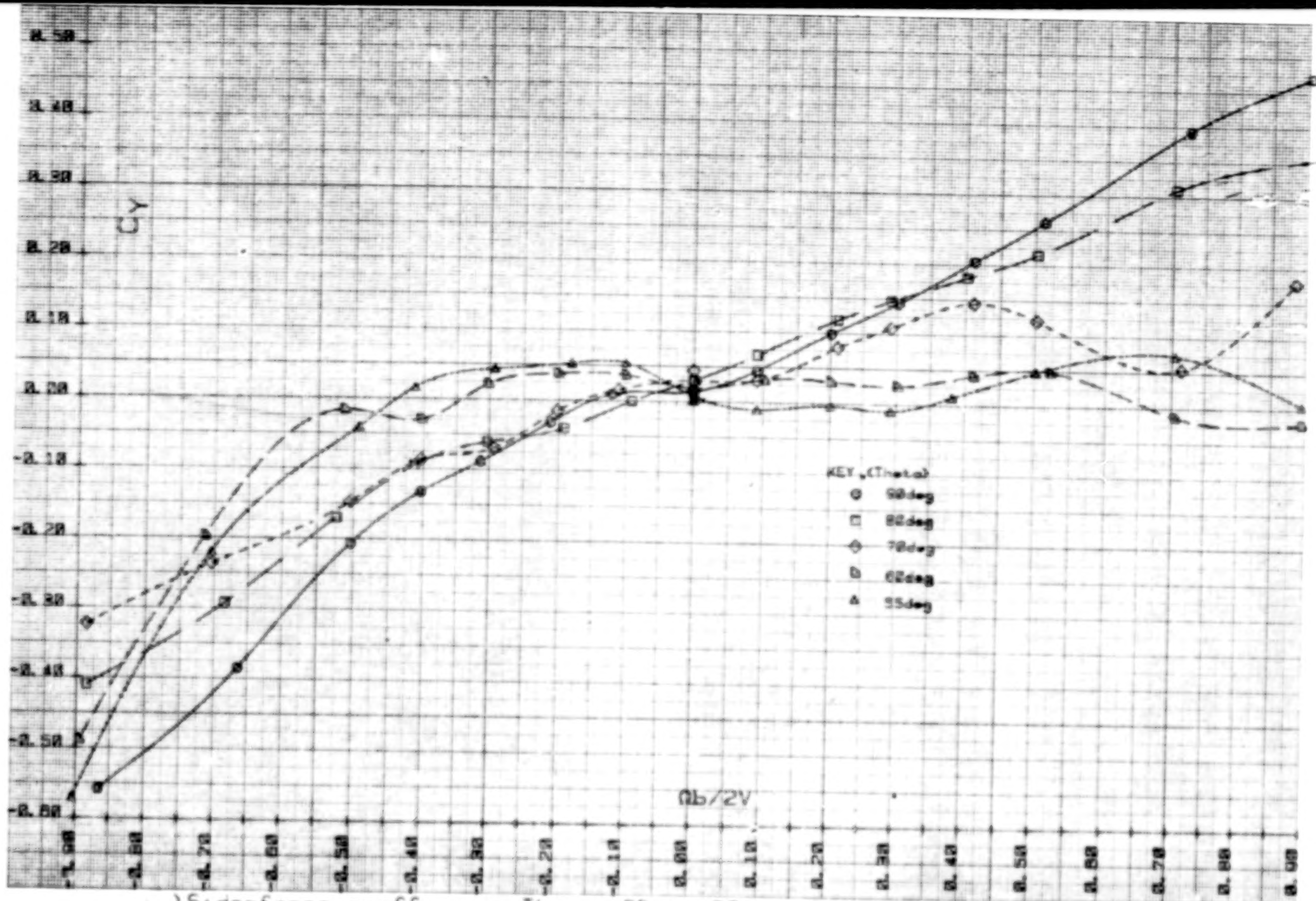
(.) Normal-force coefficient. Theta= 55 to 90deg; Phi=-0.6deg.

Figure 28.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V.



h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

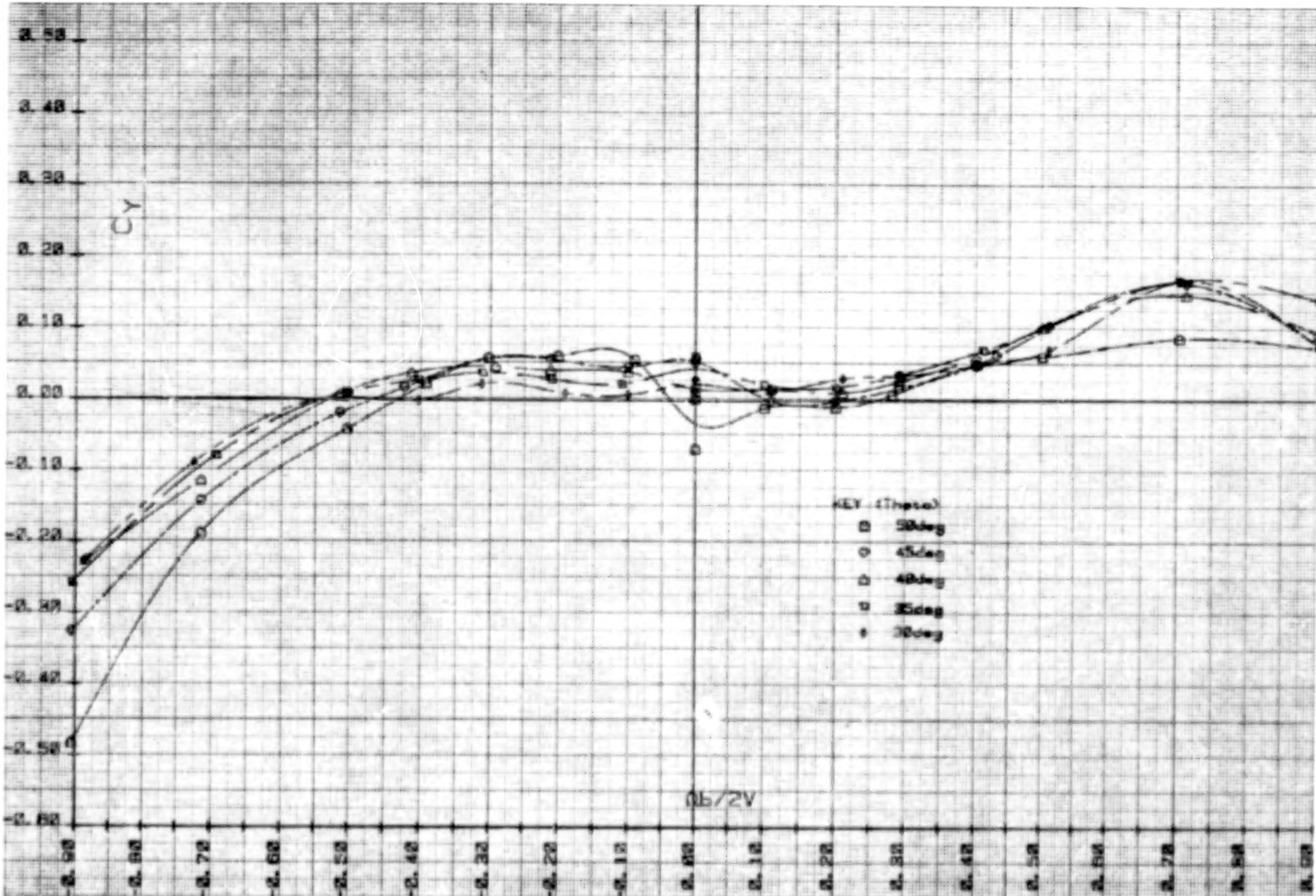
Figure 28.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V.



(.)Side-force coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

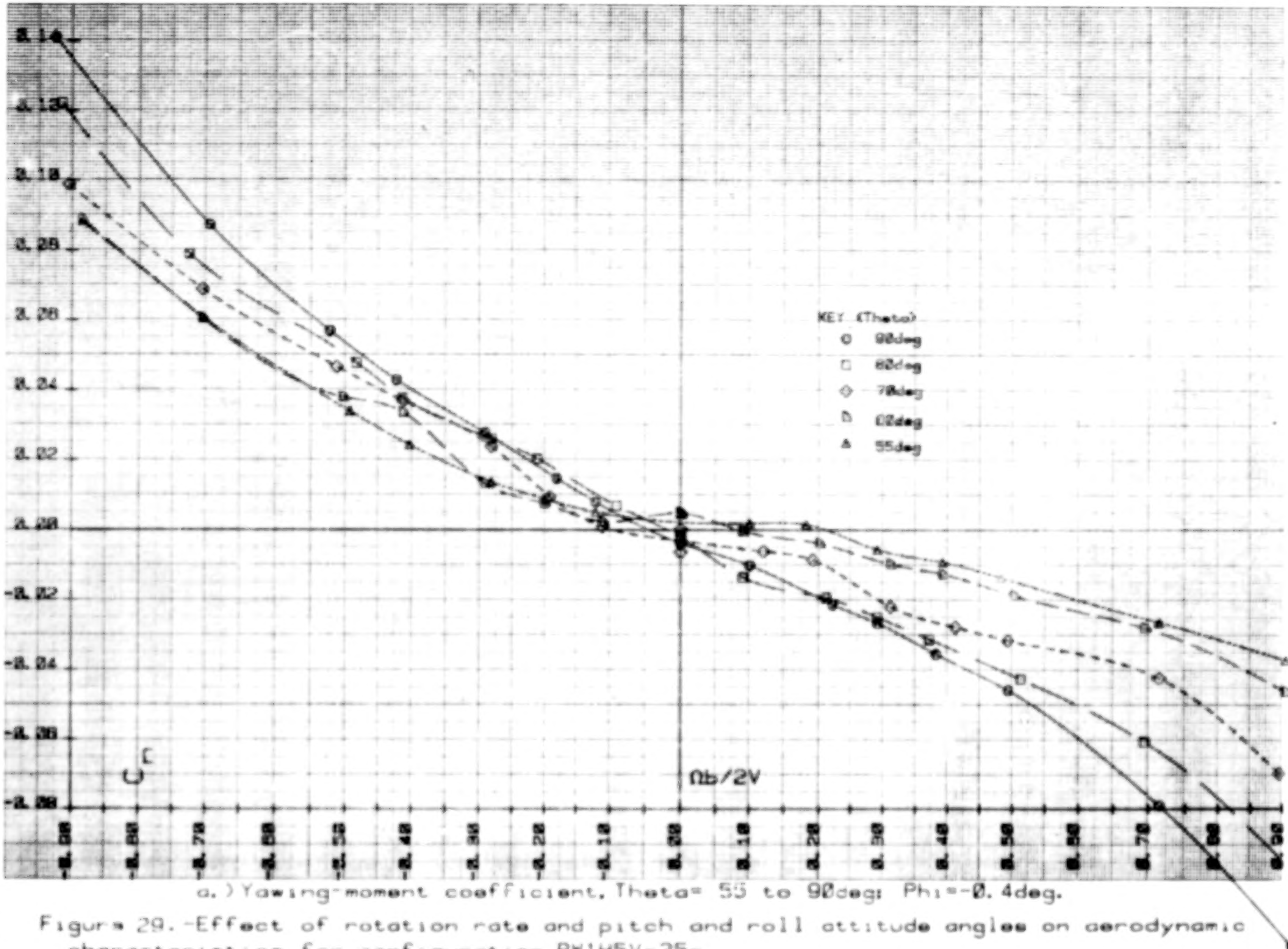
Figure 28.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V.

196



.) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

Figure 28.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 29. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V-25r.

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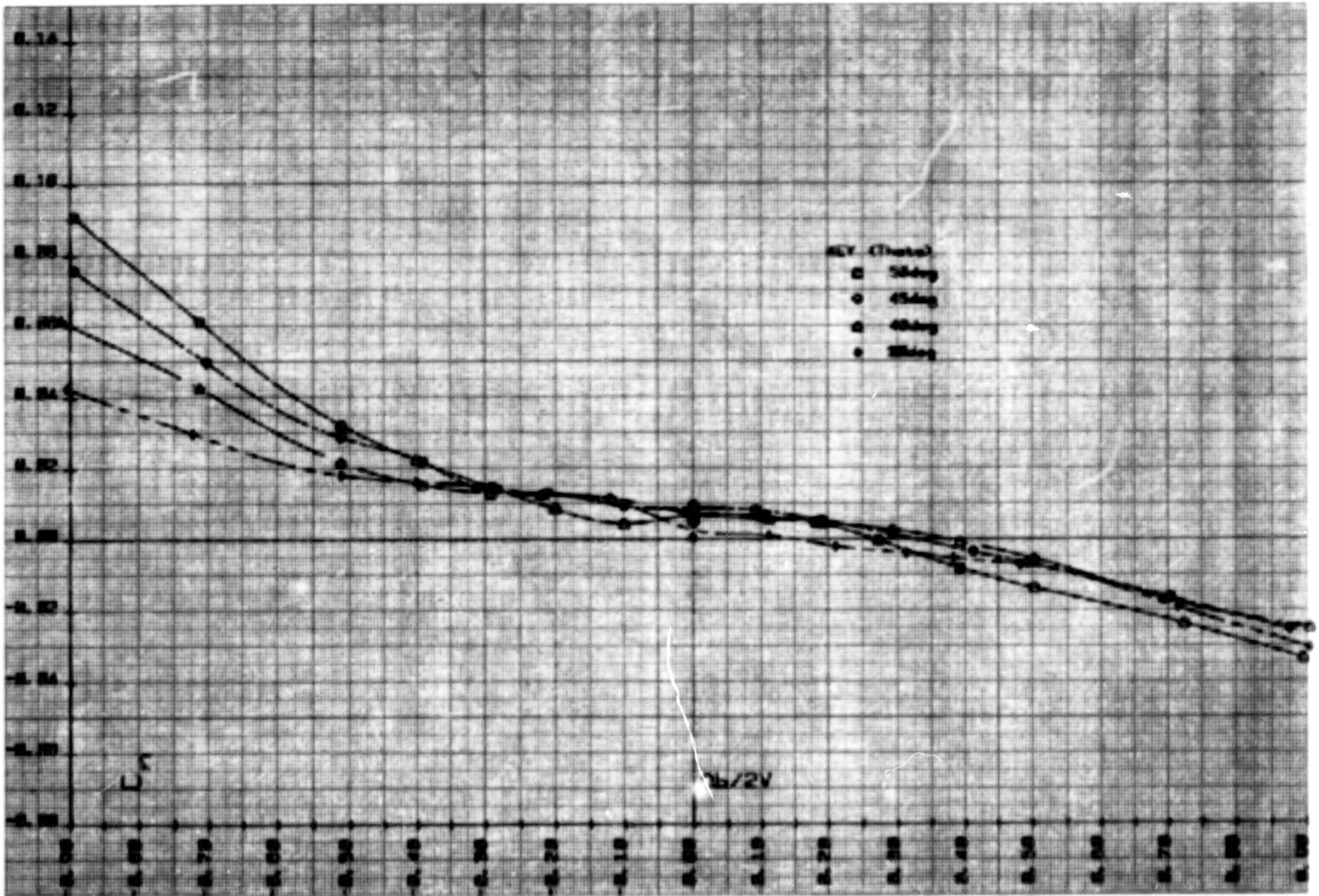
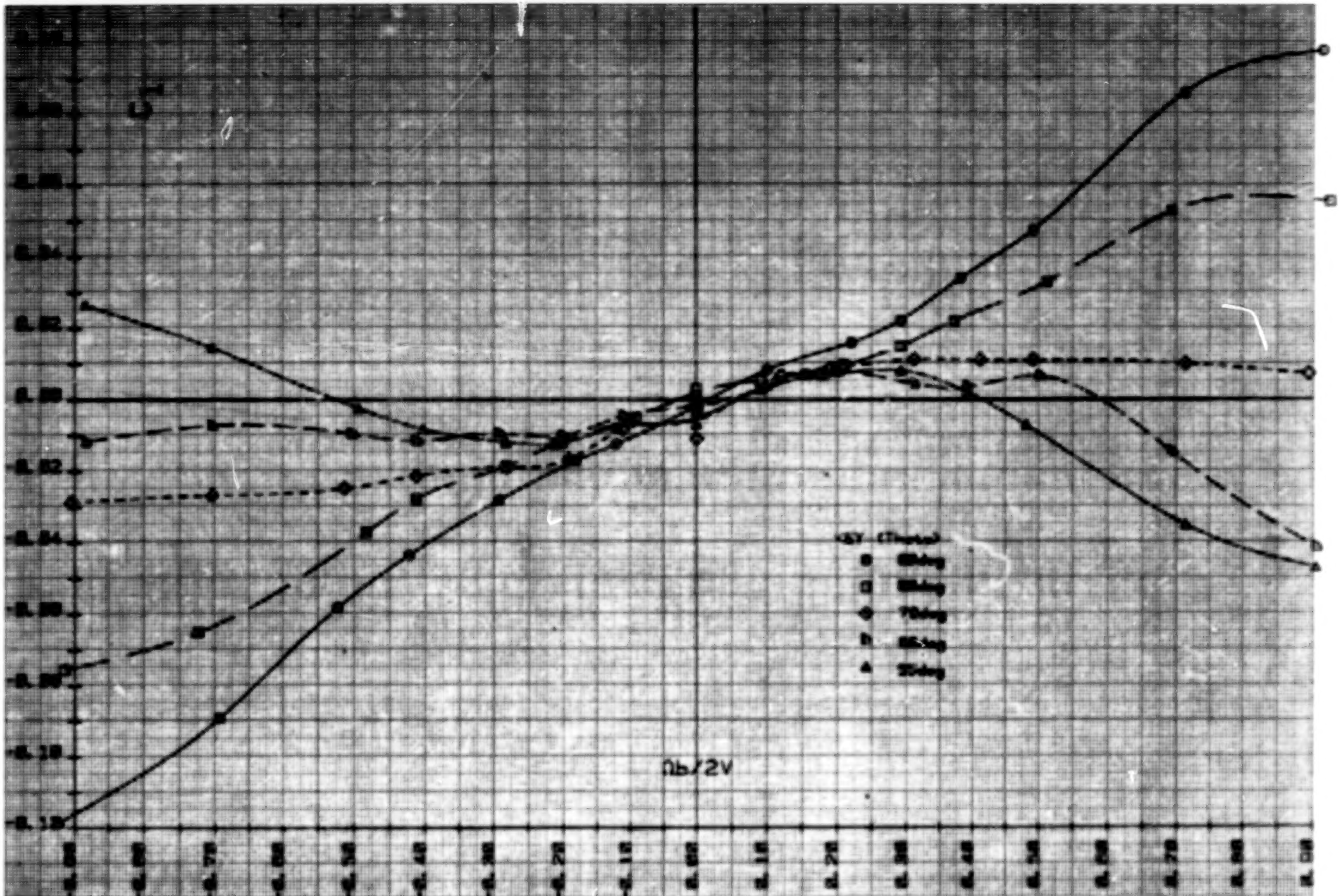


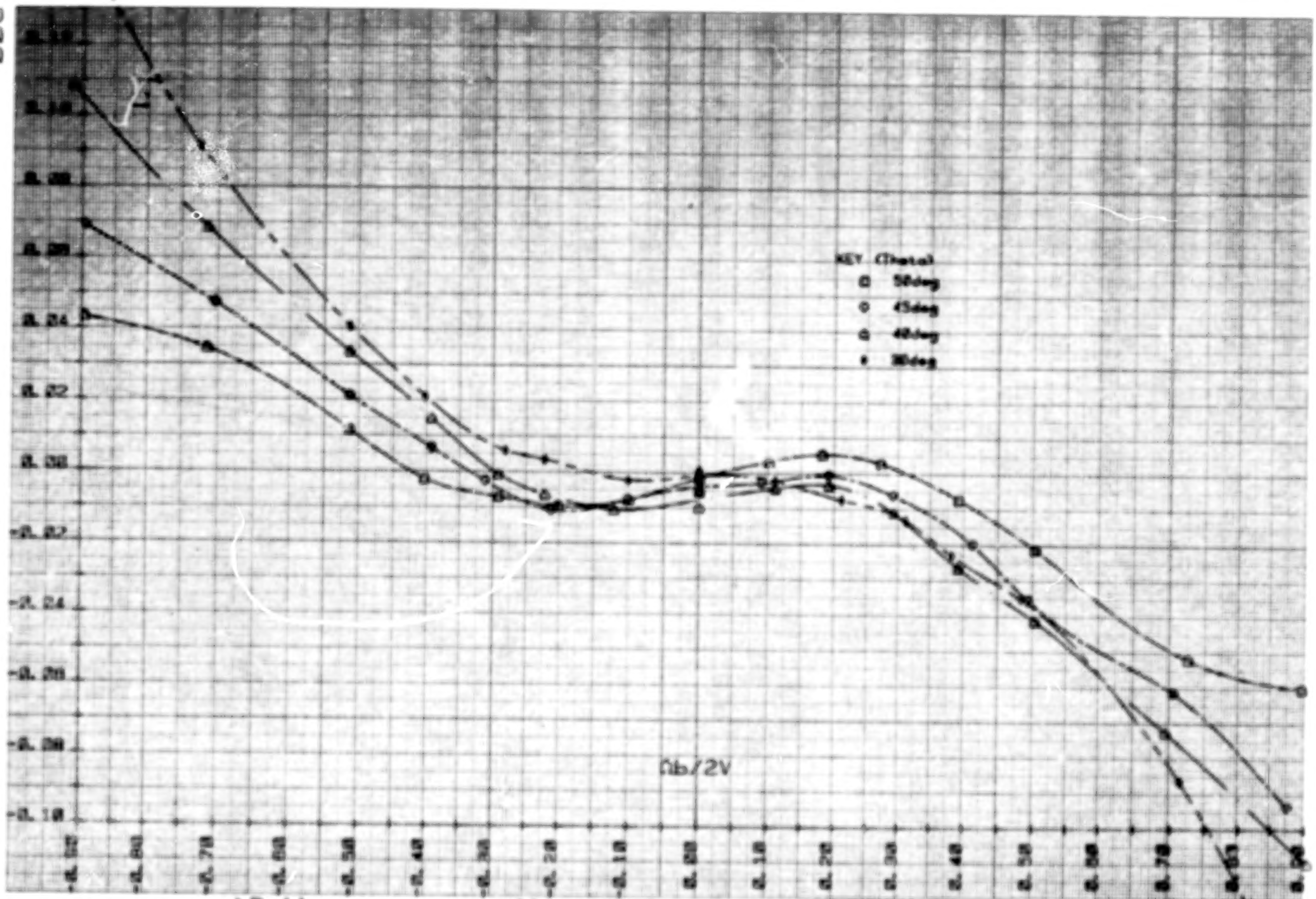
b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 29. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V-25r.



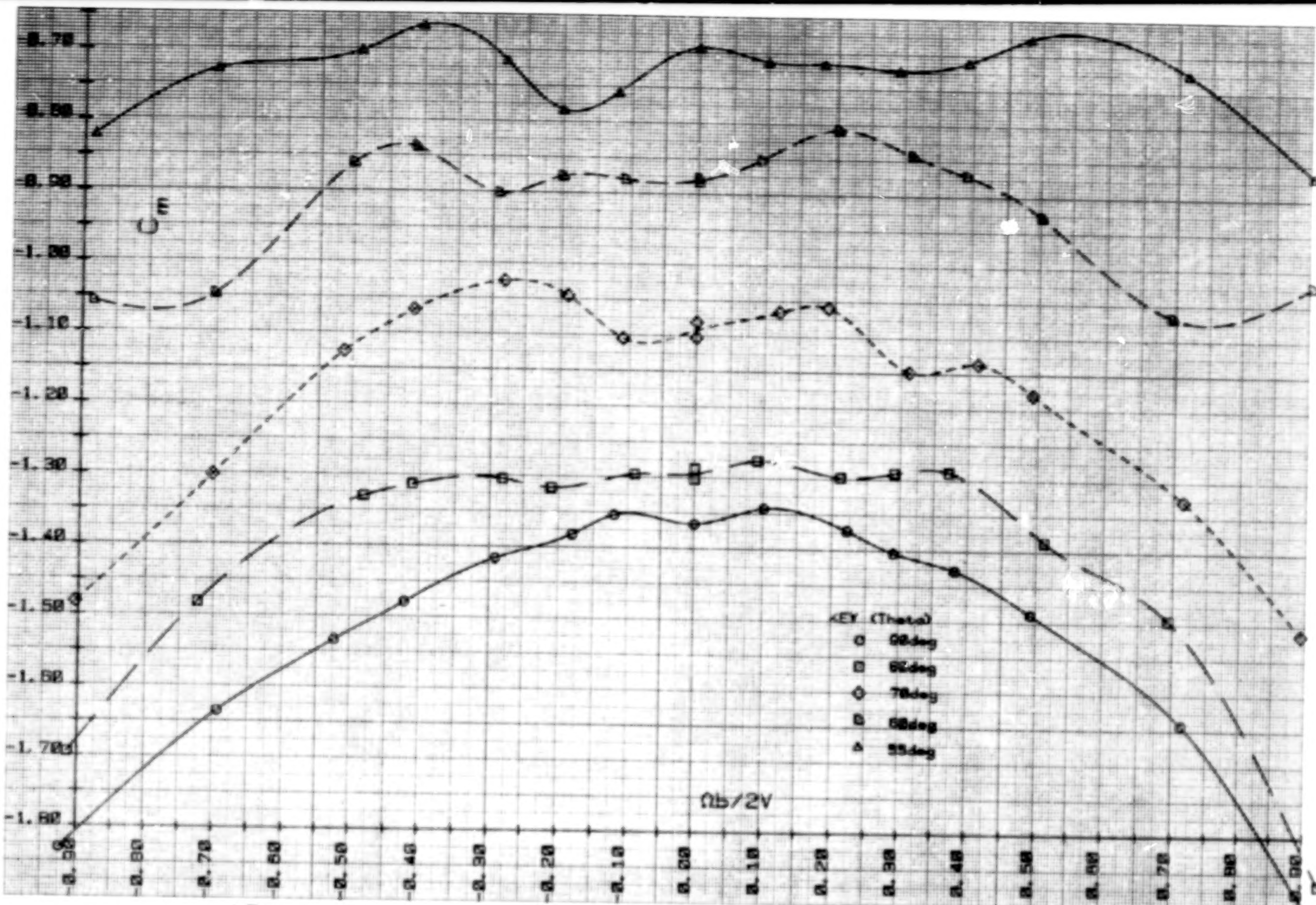
c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 29. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1HSV-25r.



[illegible])Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.0deg.

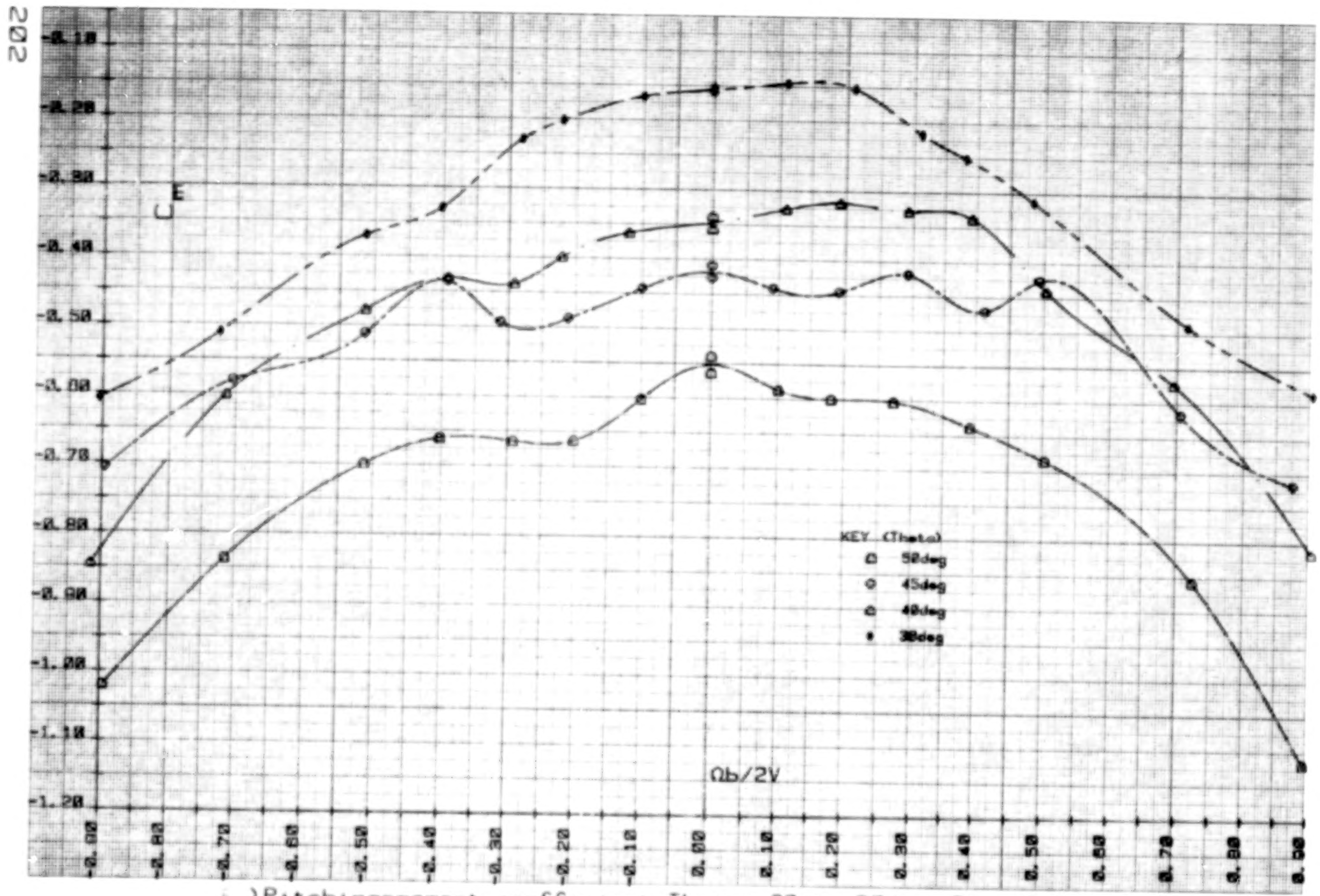
Figure 29.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V-25r.



a.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.0deg.

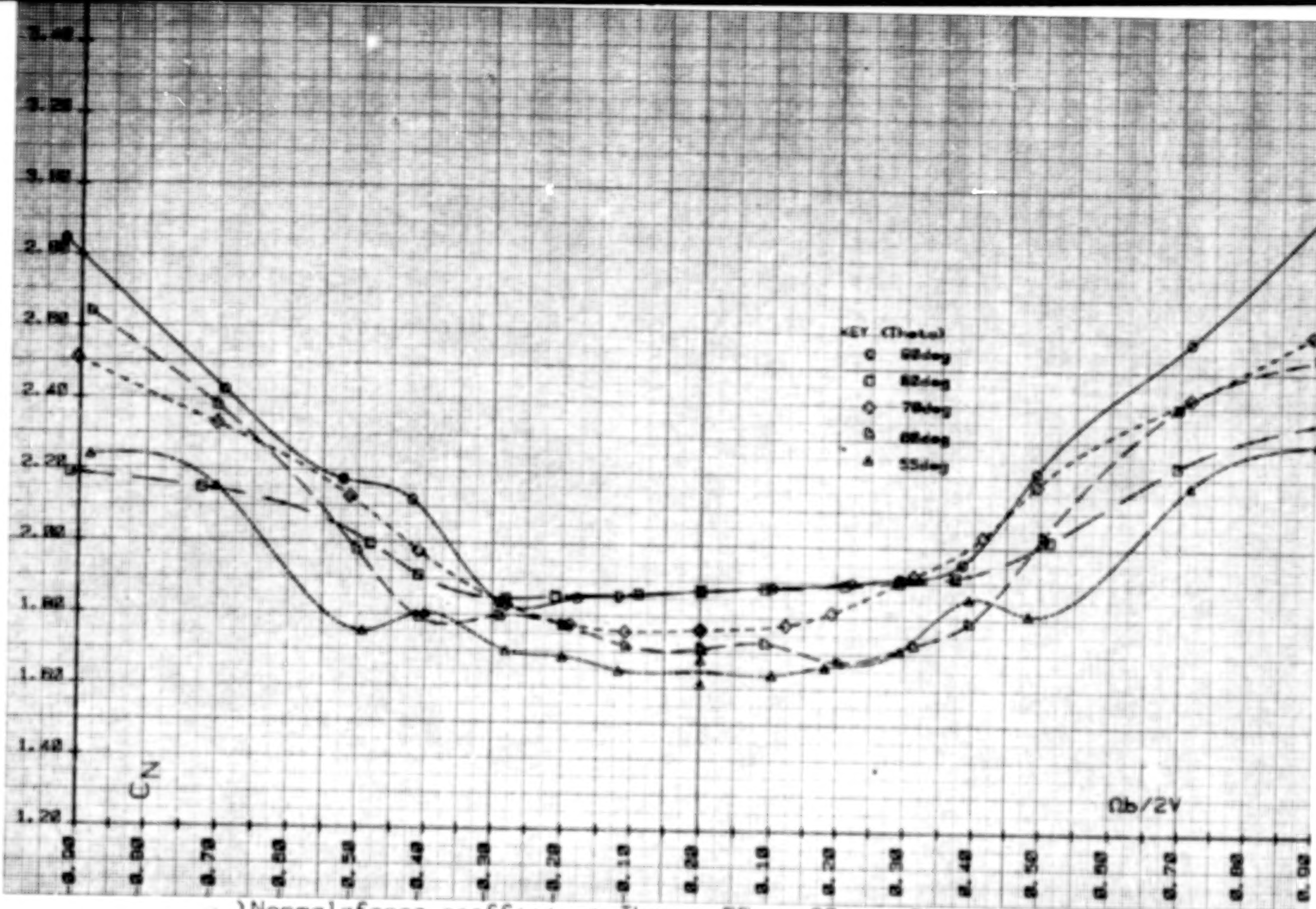
Figure 29.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V-25r.

201



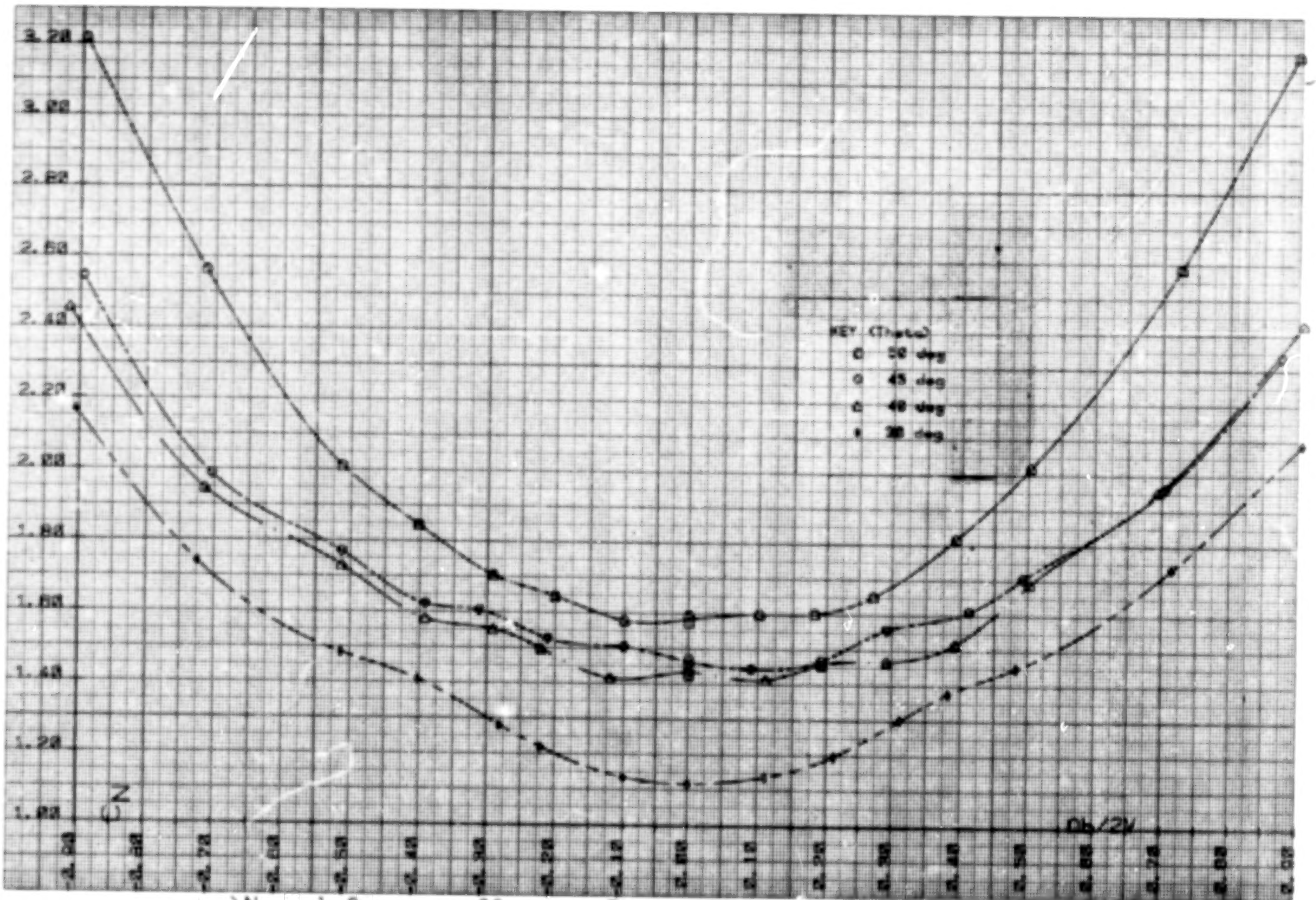
(.)Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 29.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V-25r.



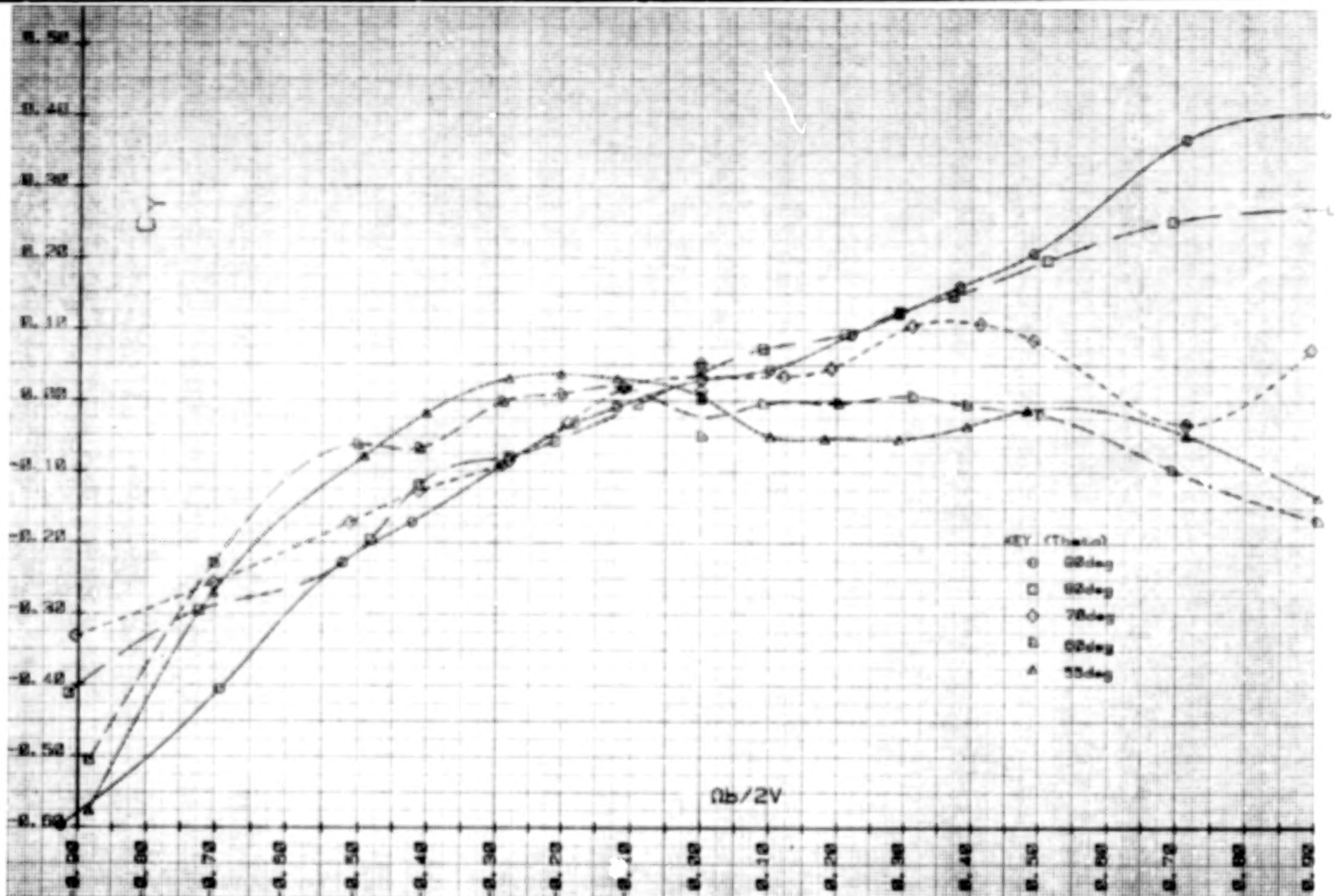
)Normal-force coefficient. Theta= 55 to 90deg; Phi=-0.0deg.

Figure 29. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V-25r.



(a) Normal-force coefficient. Theta= 30 to 50deg; Phi=-0.0deg.

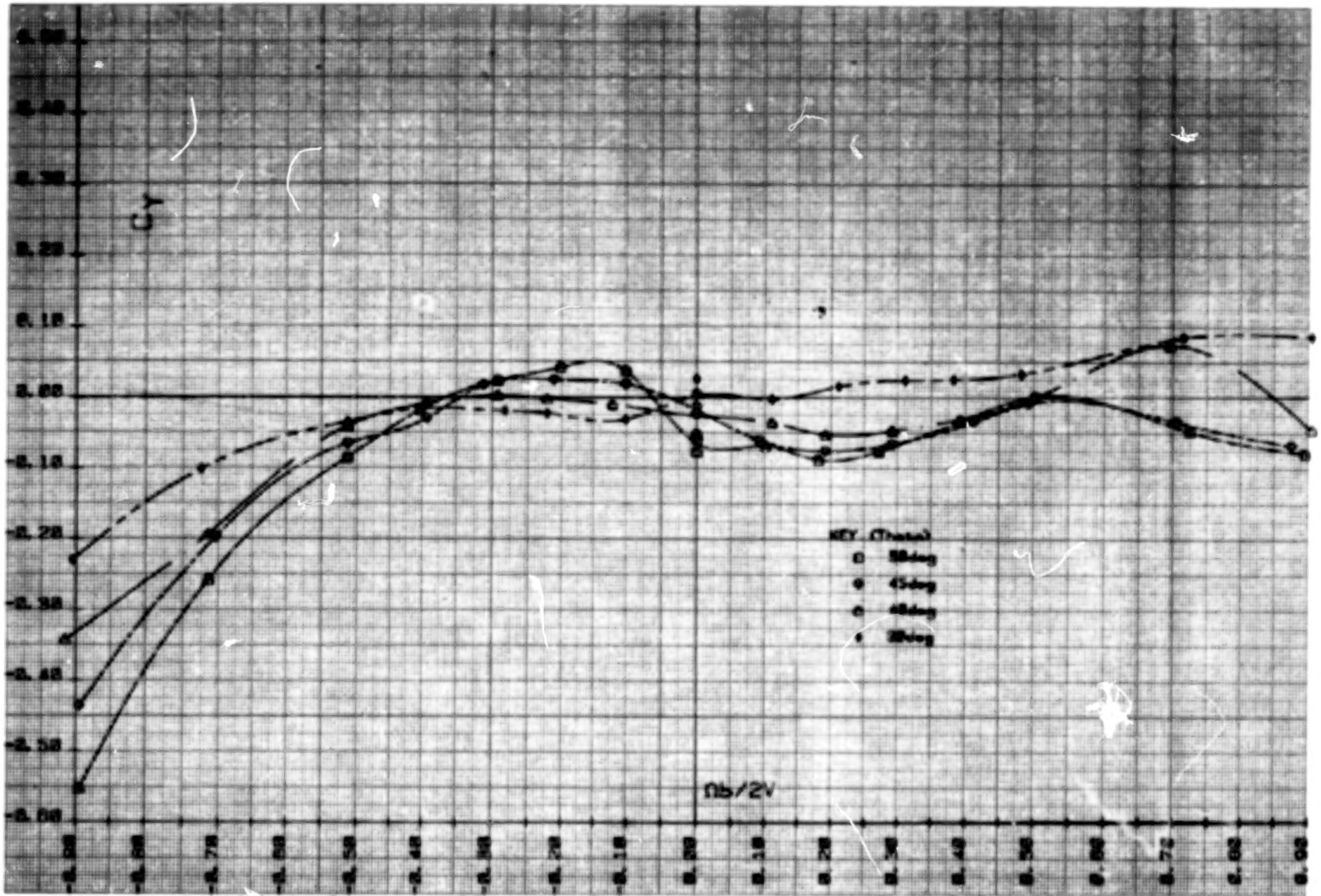
Figure 29. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V-25r.



(.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

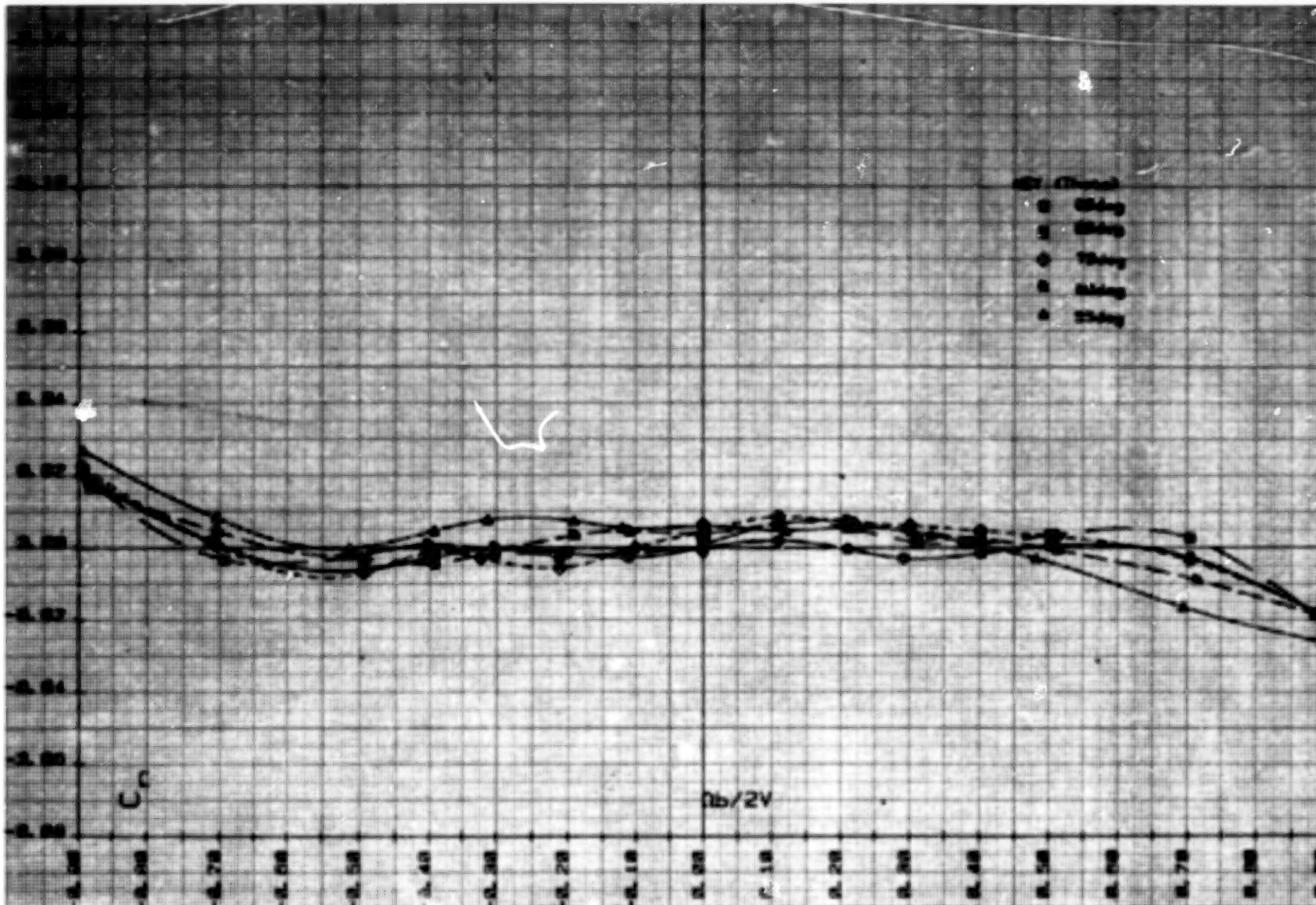
Figure 28.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V-25r.

205



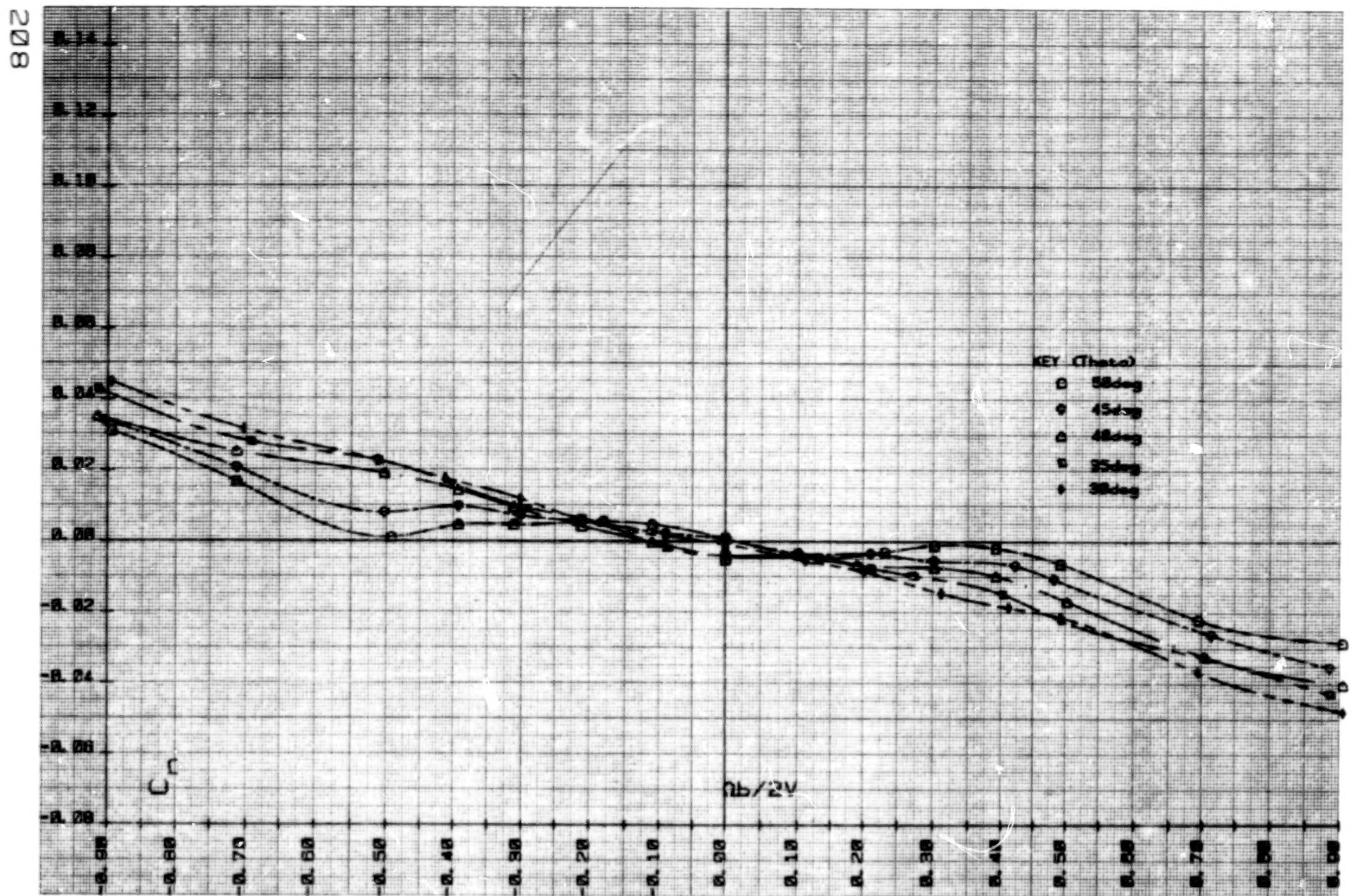
j.) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.0deg.

Figure 29. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H5V-25r.



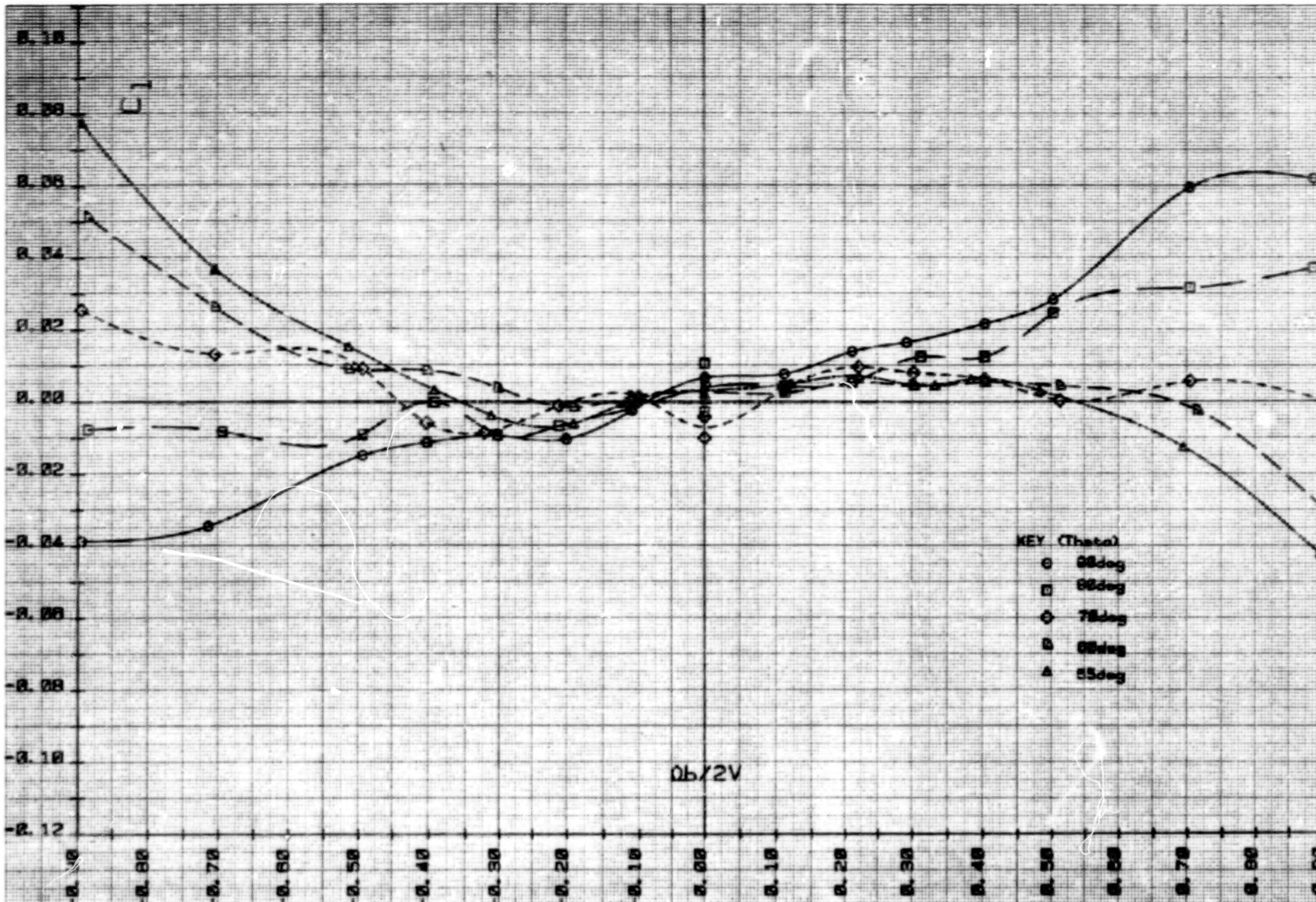
a.) Yawing-moment coefficient. Theta= 55 to 90deg; Phi=-0.3deg.

Figure 30.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1HVTT.



b.) Yawing-moment coefficient. Theta= 30 to 50deg; Phi=-0.4deg.

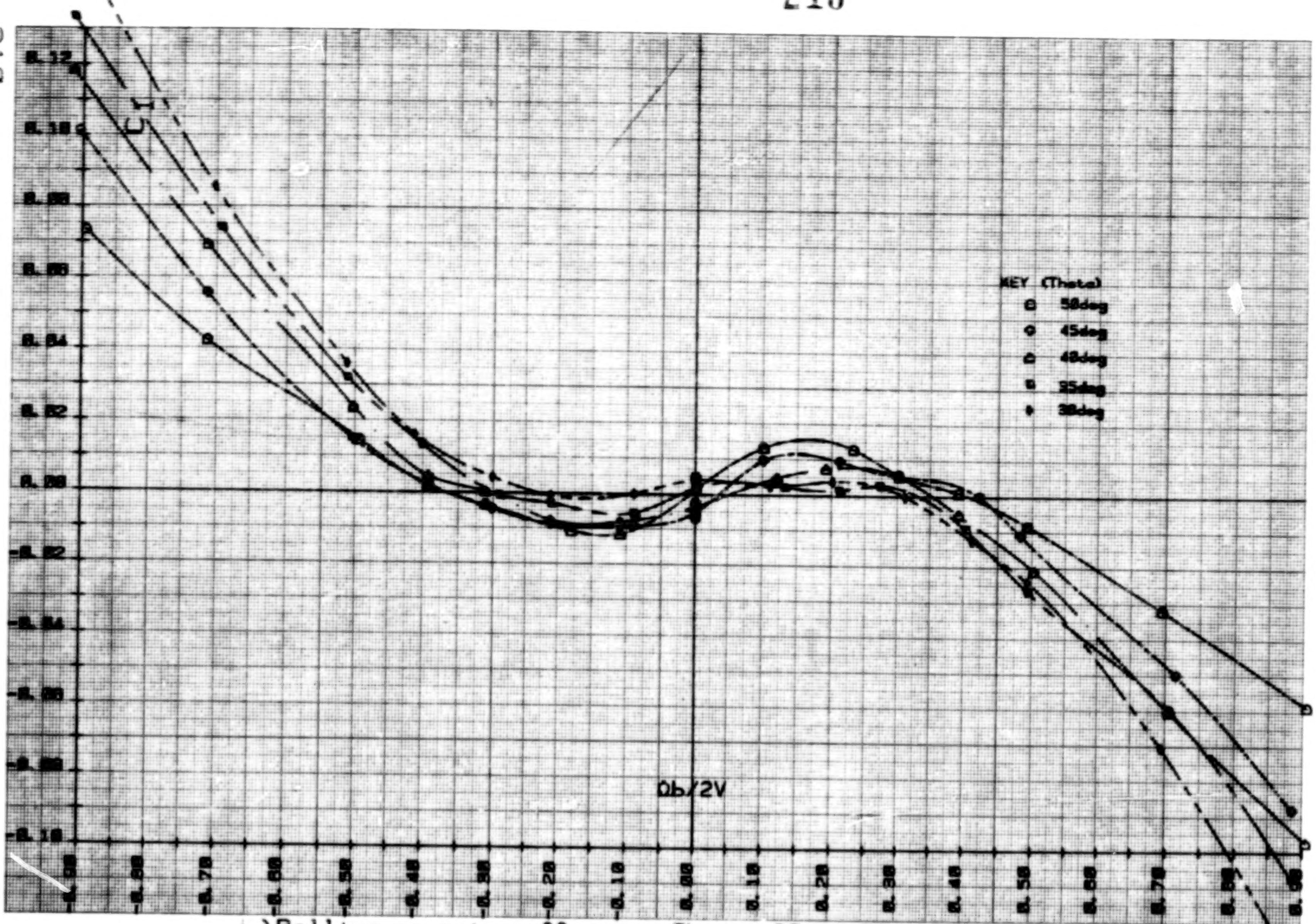
Figure 30. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1HVTT.



c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

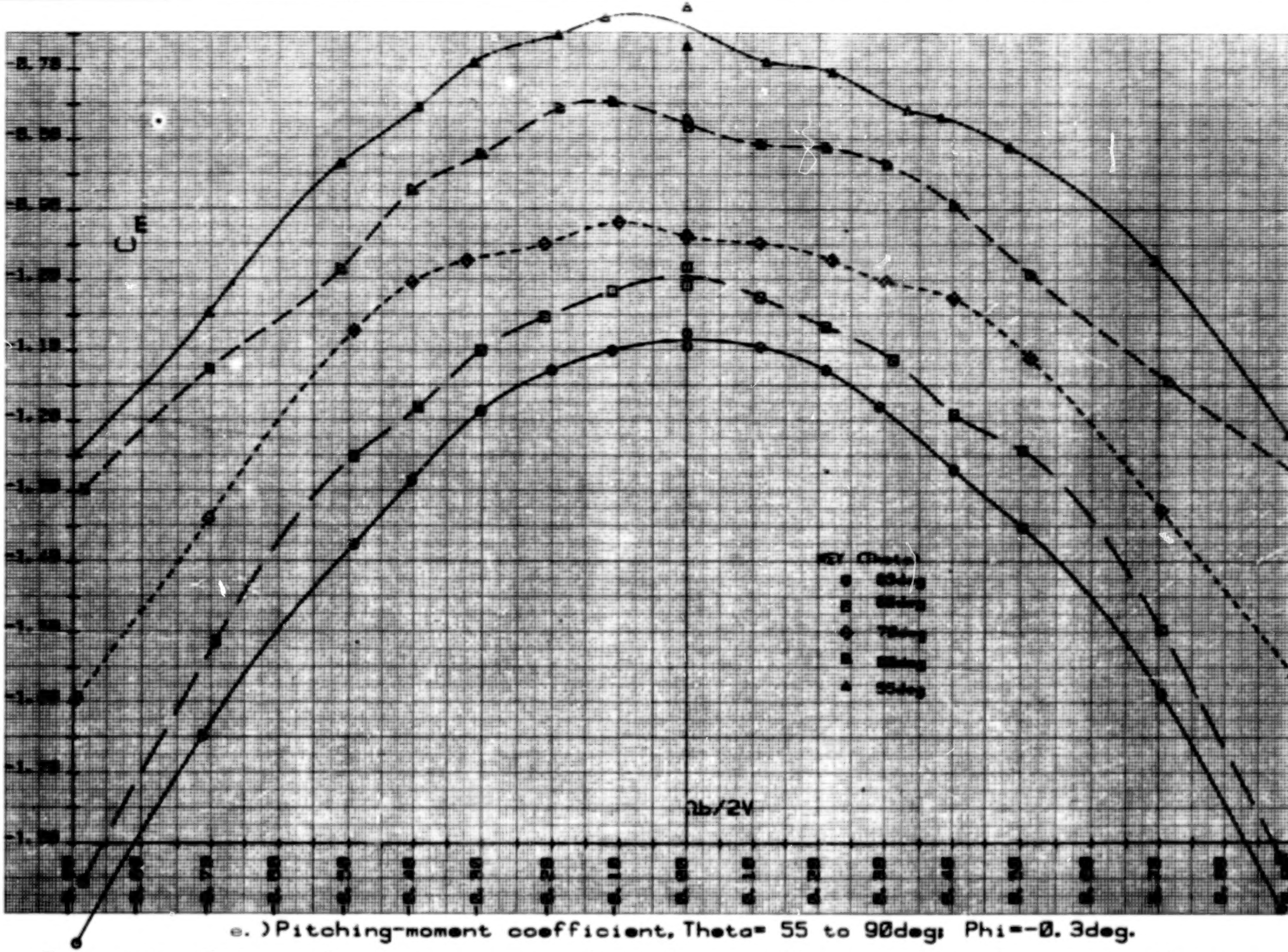
Figure 30. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1HVTT.

210



d.) Rolling-moment coefficient. Theta= 30 to 50deg; Phi=-0.4deg.

Figure 30.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1HVTT.



e.)Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 30.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1HVTT.

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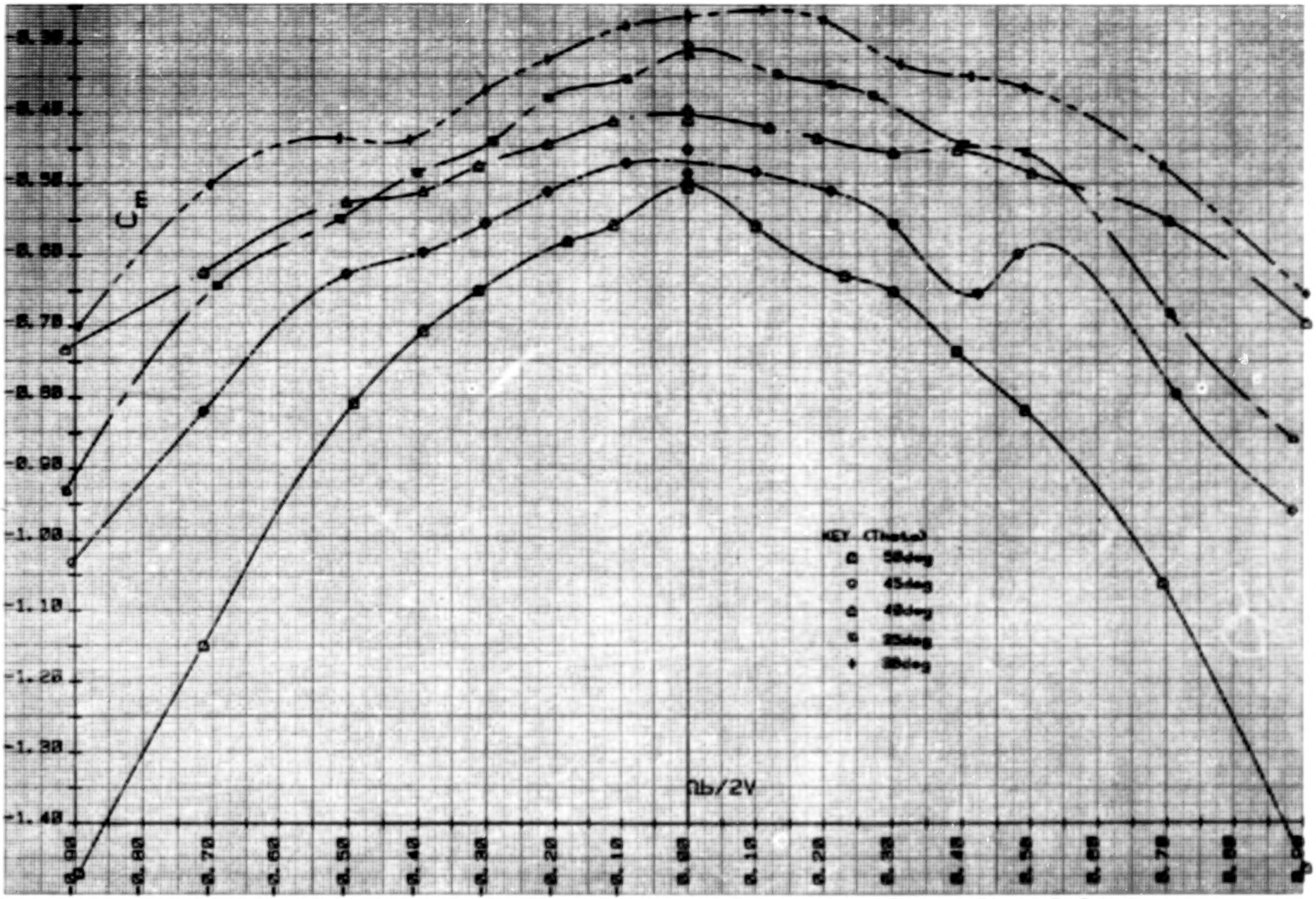
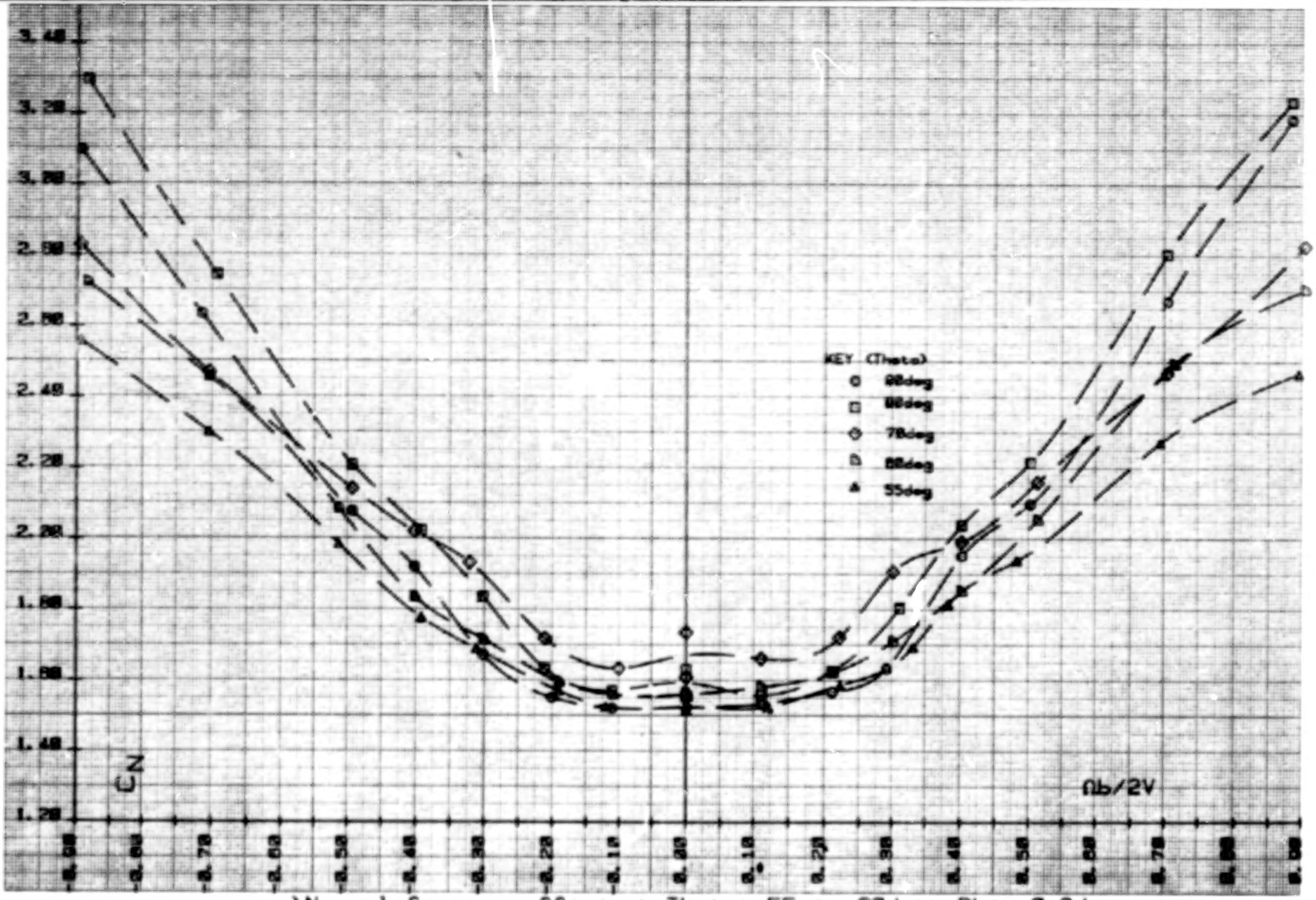


(f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

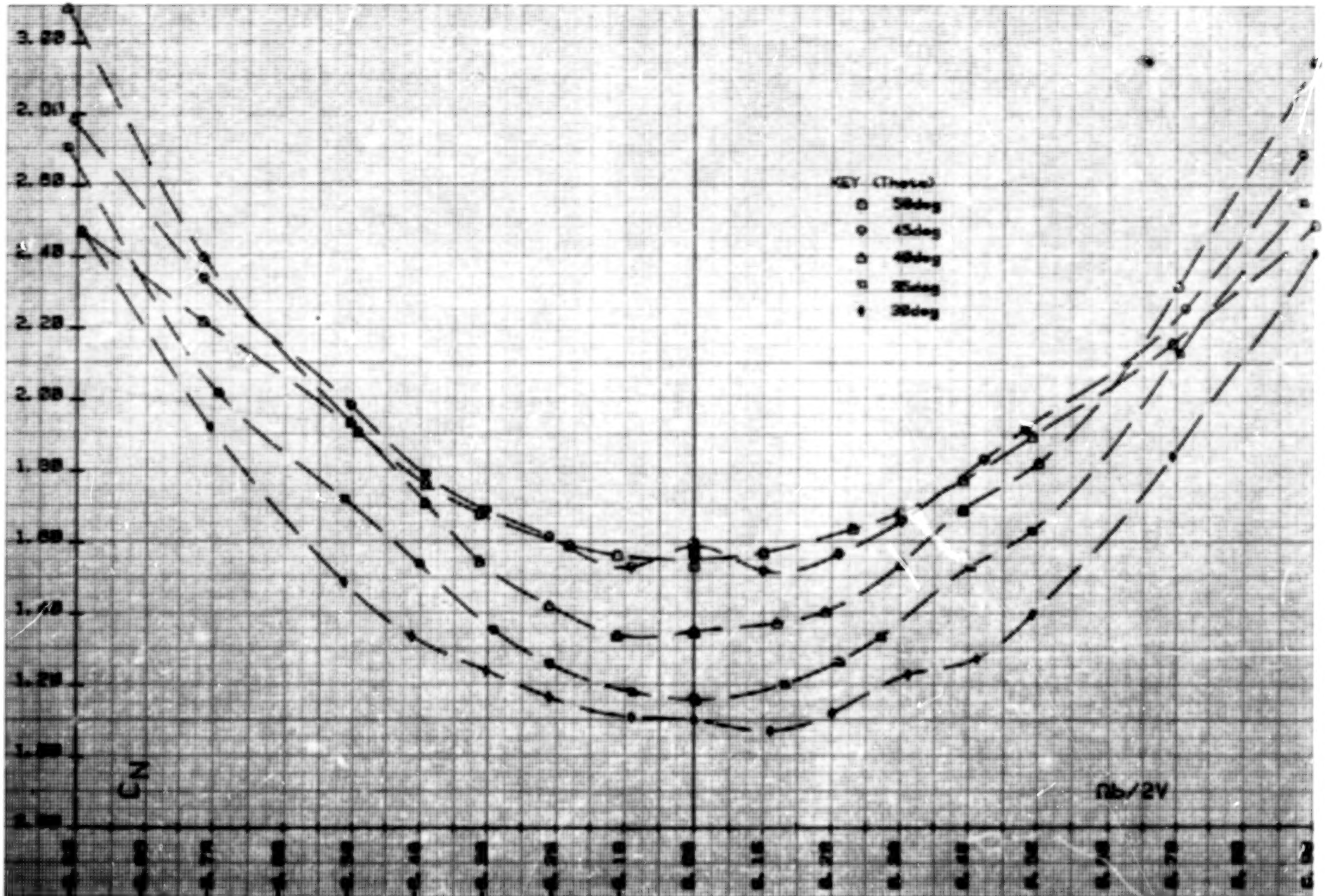
Figure 30.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1HVTT.



g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

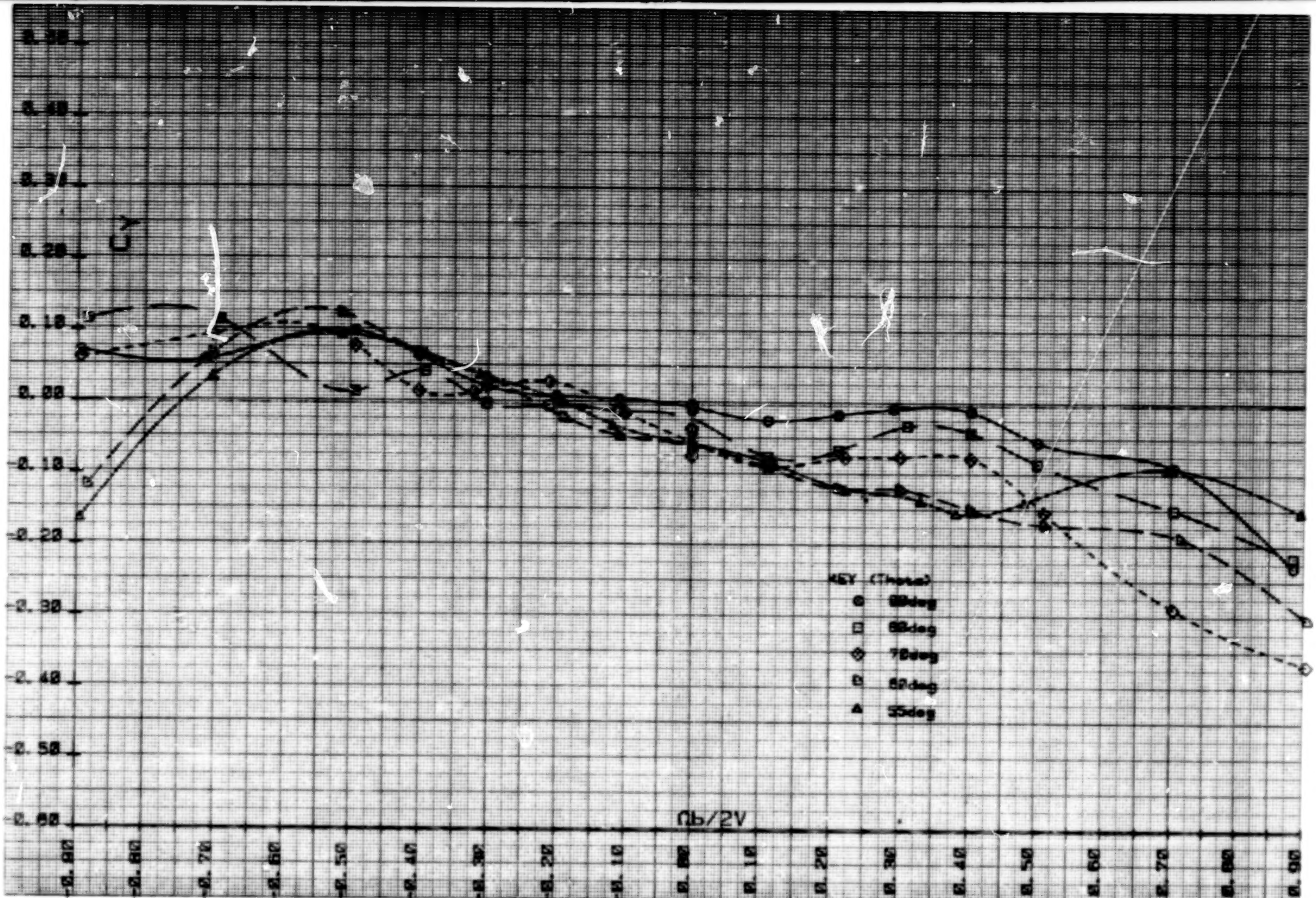
Figure 30.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1HVTT.

213



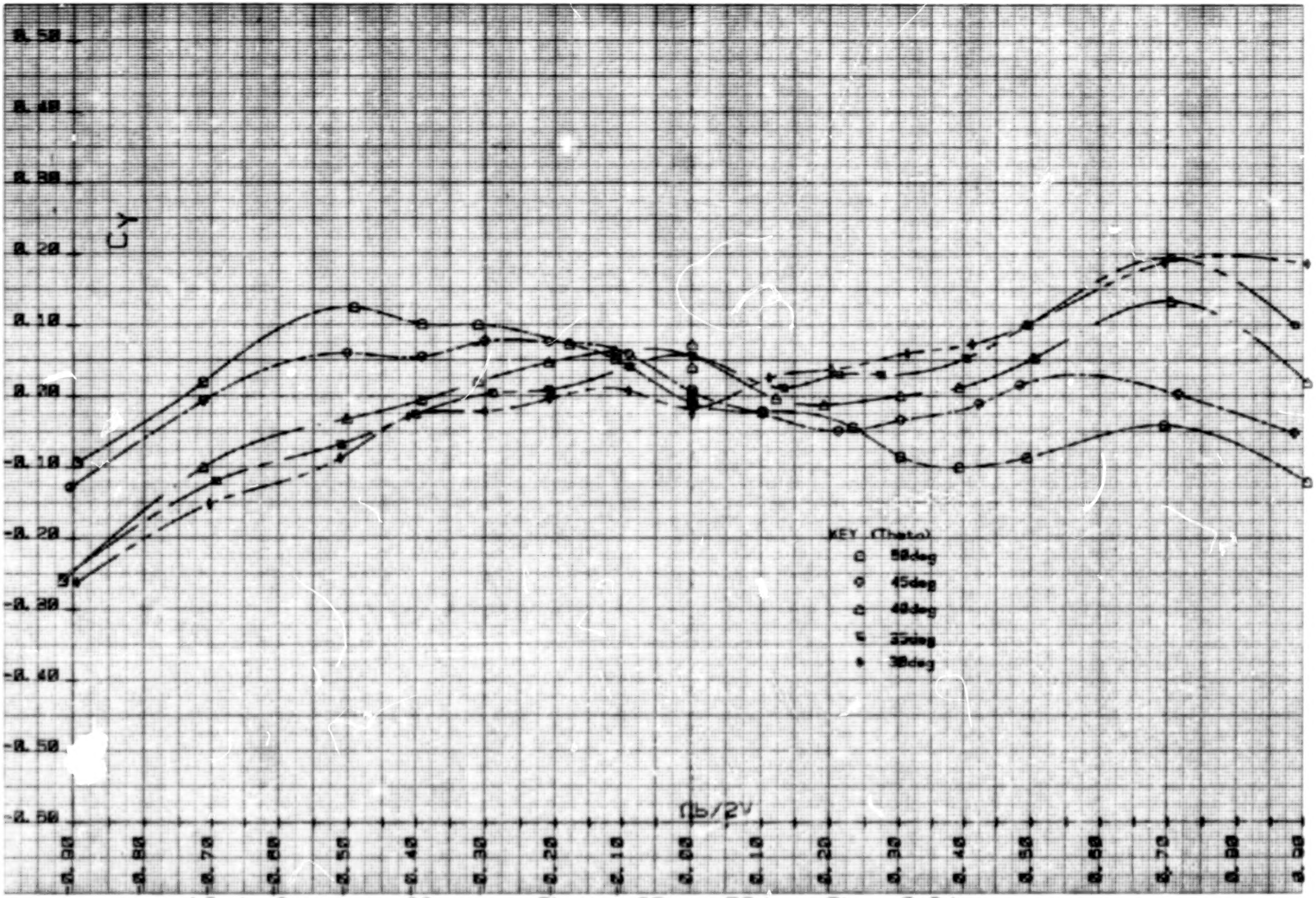
h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 30.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1HVTT.



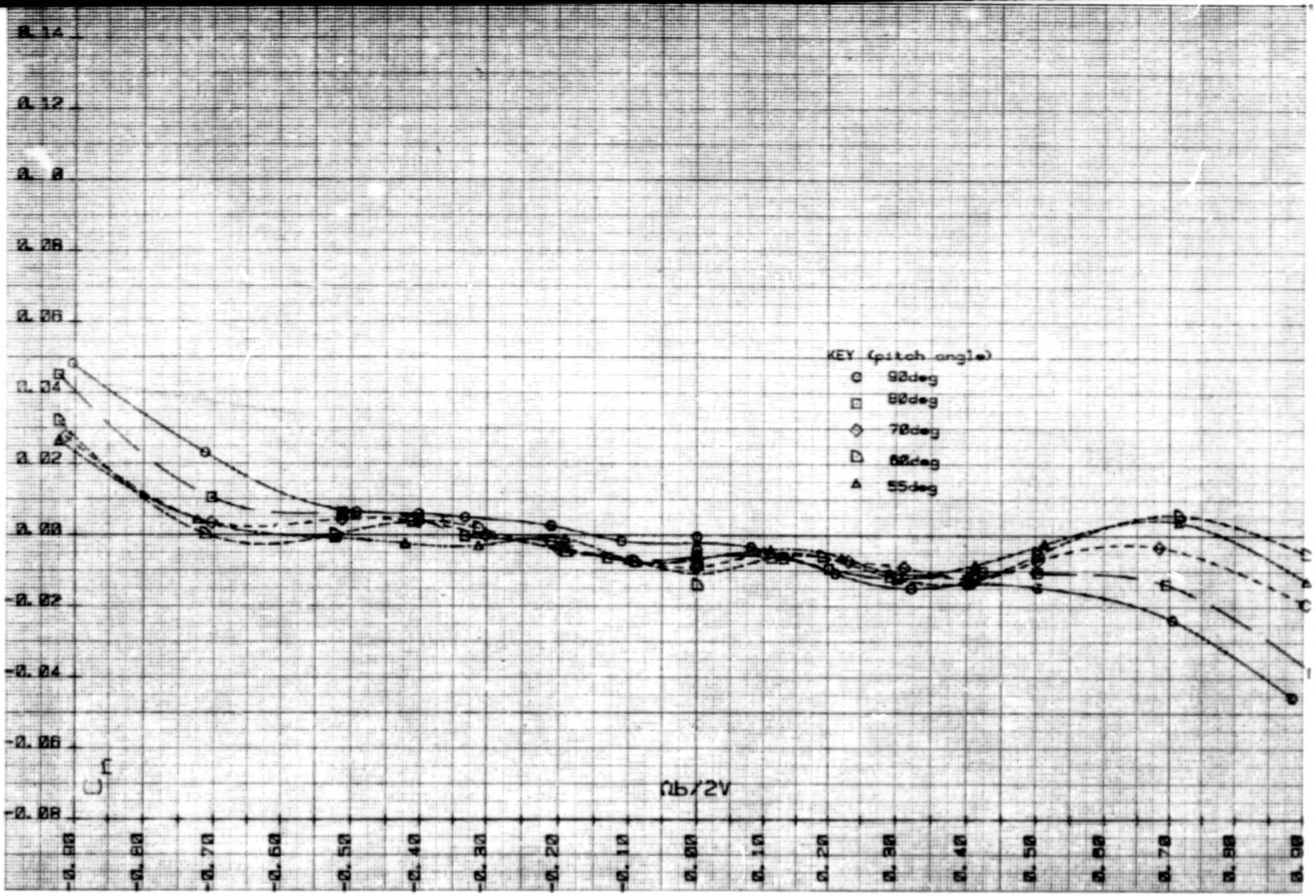
(.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 30.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1HVTT.



( )Side-force coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 30.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1HVTT.



a.) Yawing-moment coefficient, Theta= 55 to 90deg Phi=-0.0deg.

Figure 31.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V.

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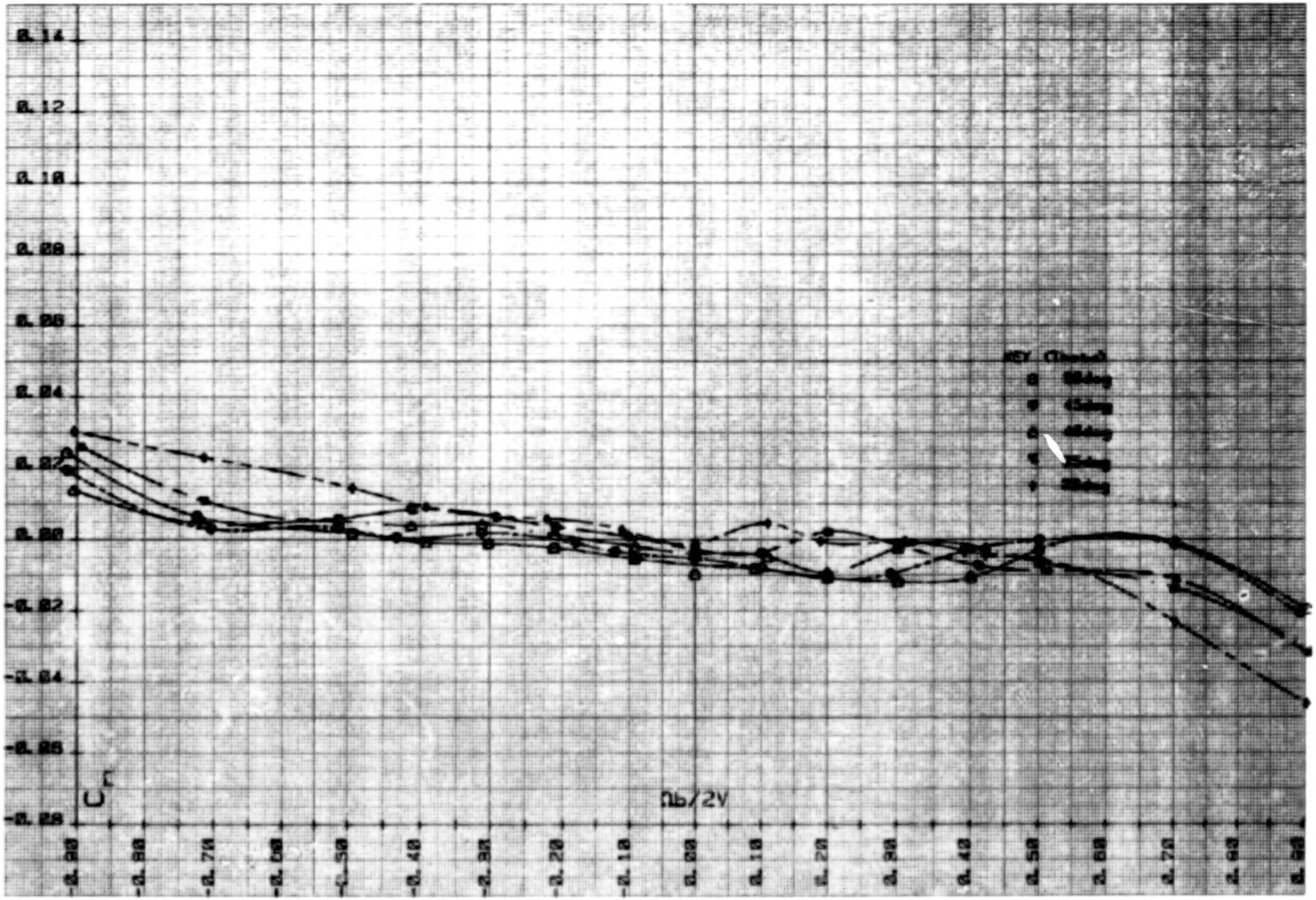
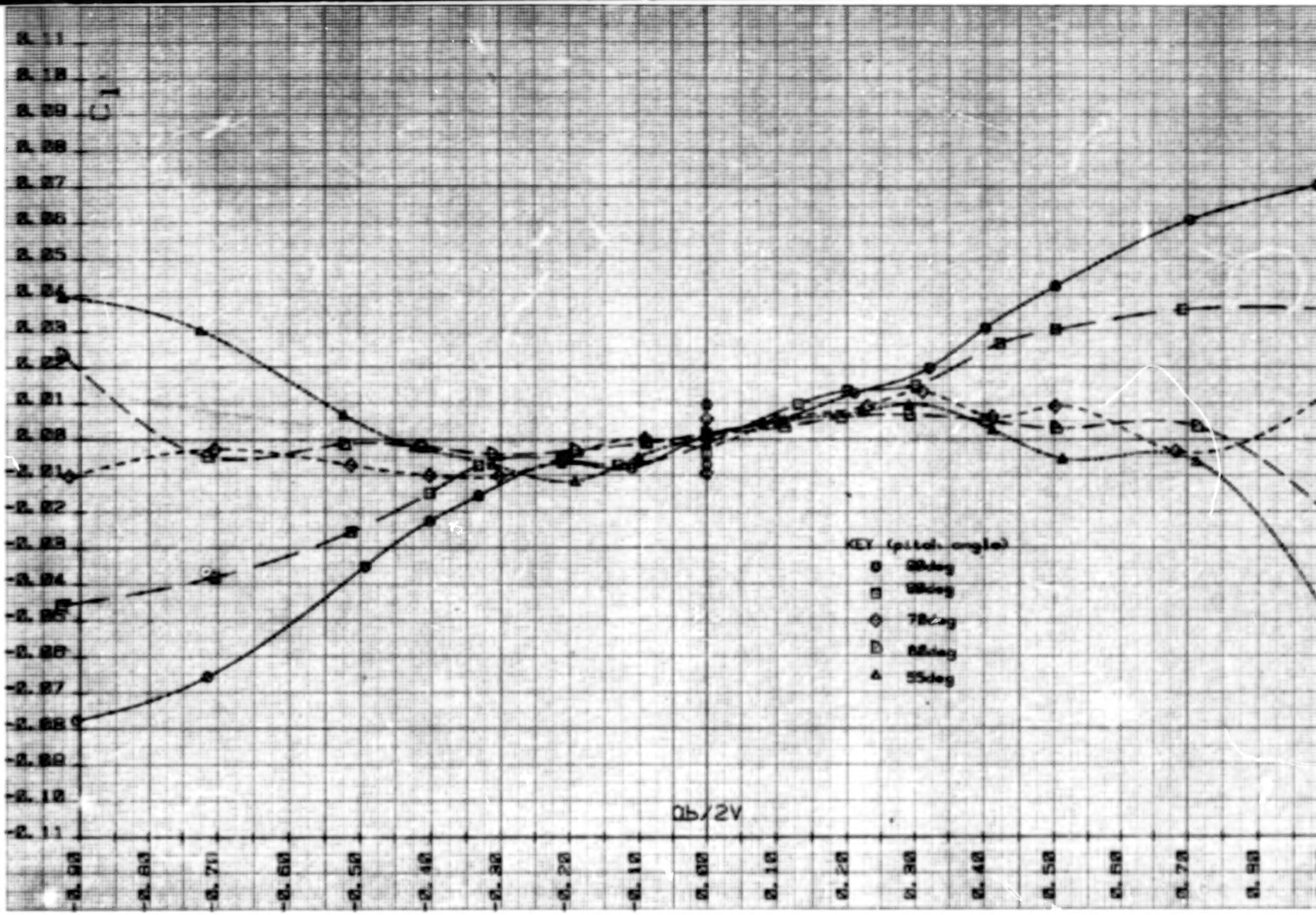


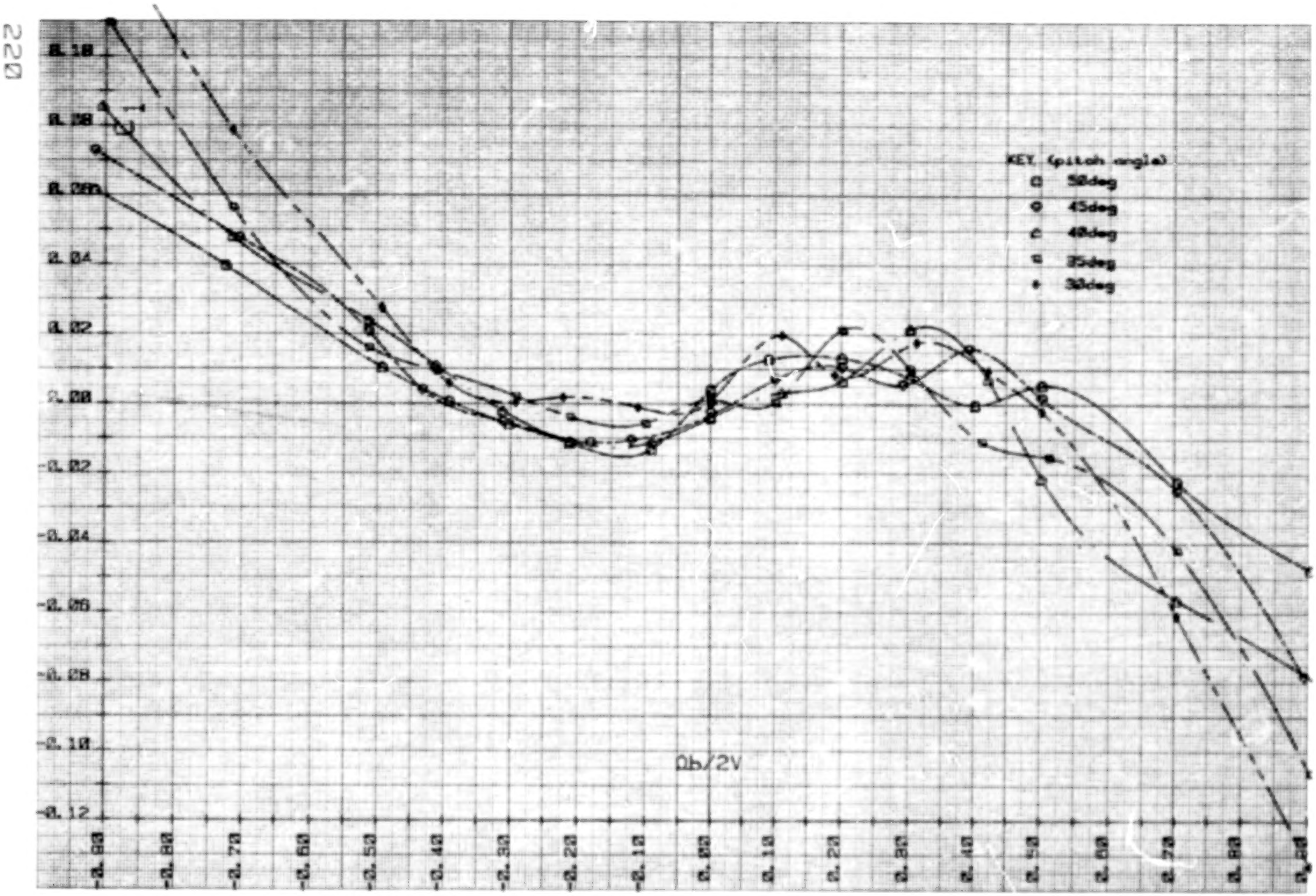
b.) Yawing-moment coefficient, Theta= 30 to 50deg Phi=-0.0deg.

Figure 31.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V.



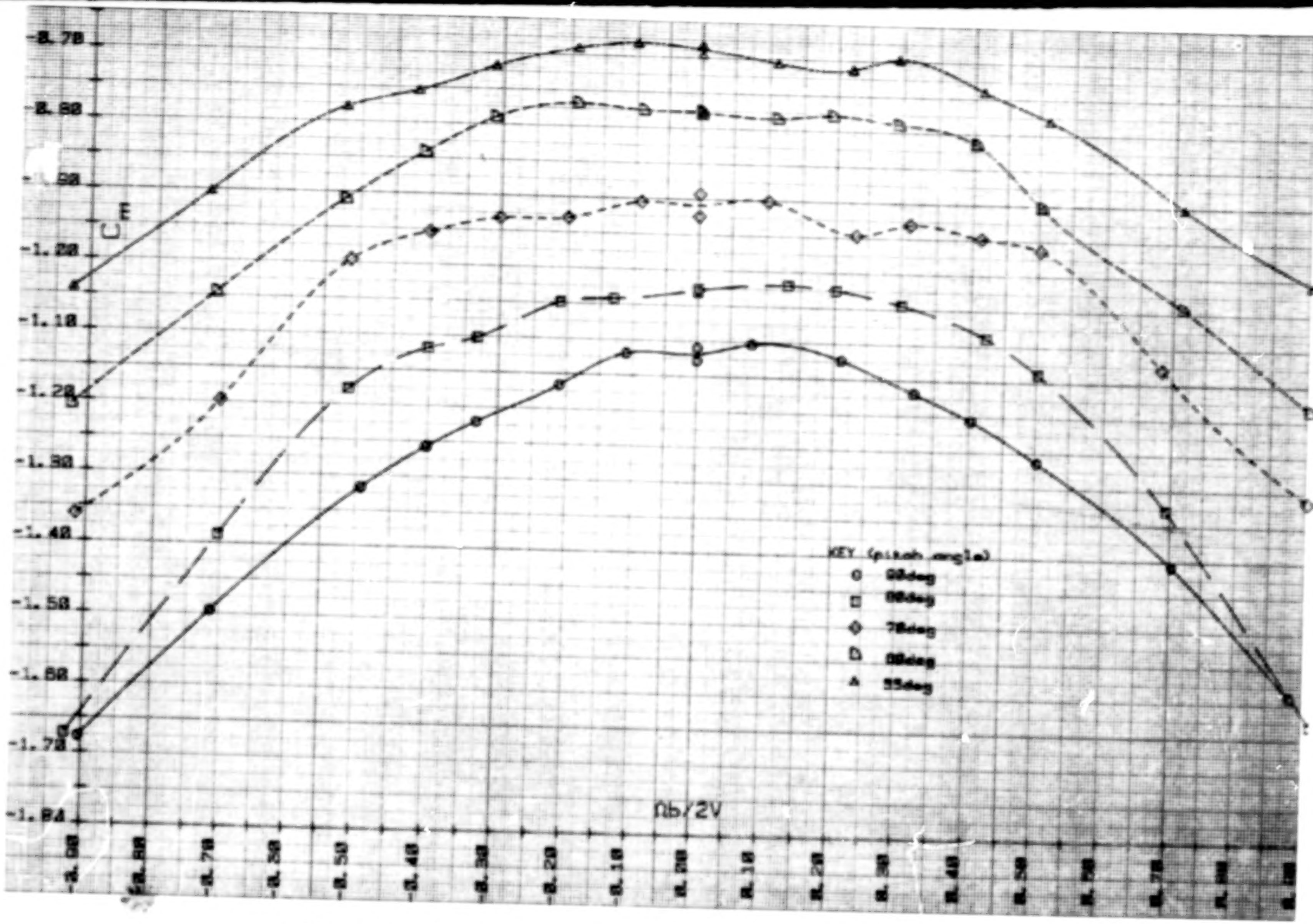
c.) Rolling-moment coefficient, Theta= 55 to 90deg Phi=-0.2deg.

Figure 31.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V.



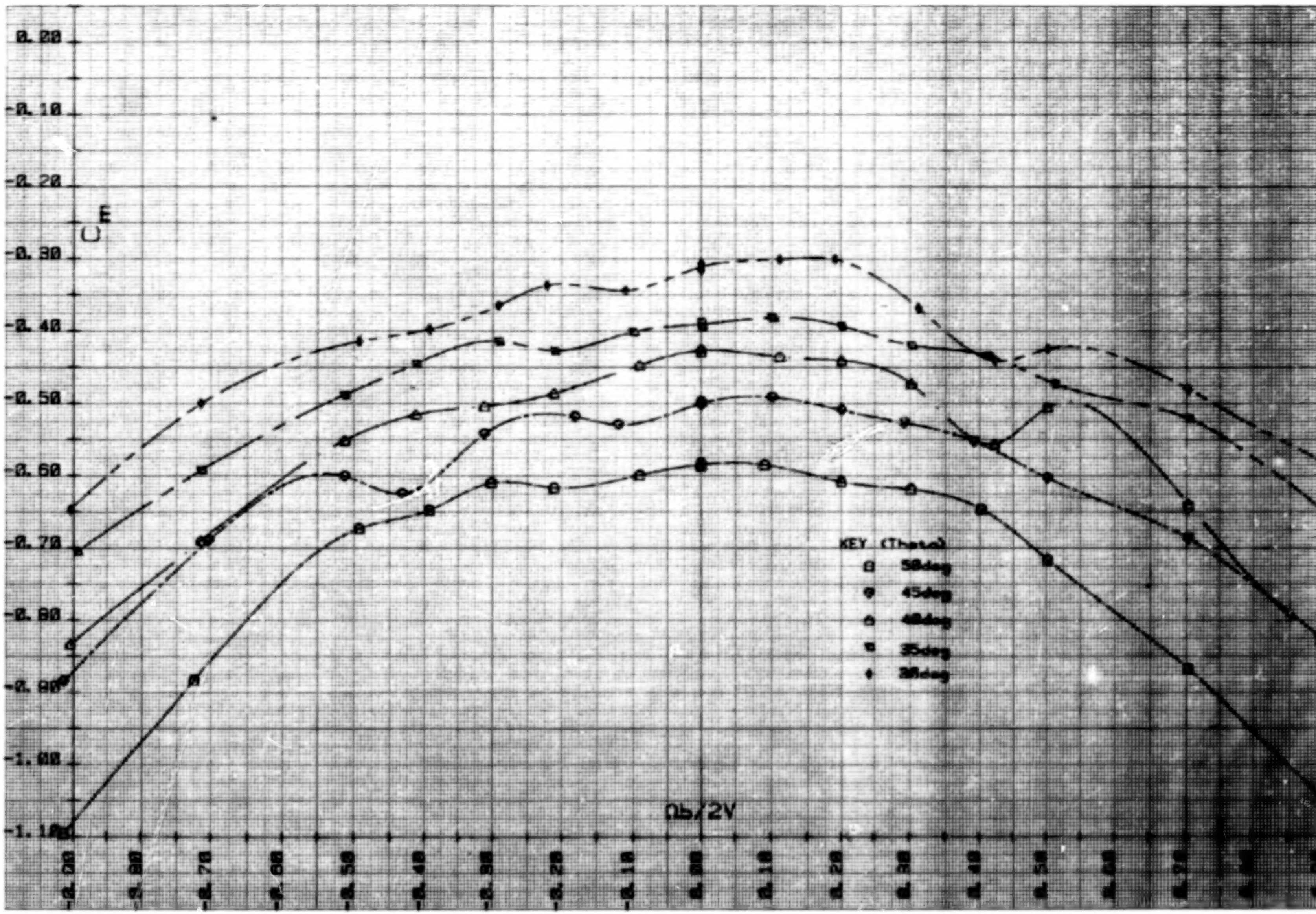
(a) Rolling-moment coefficient. Theta= 30 to 50deg Phi= 0.1deg.

Figure 31.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V.

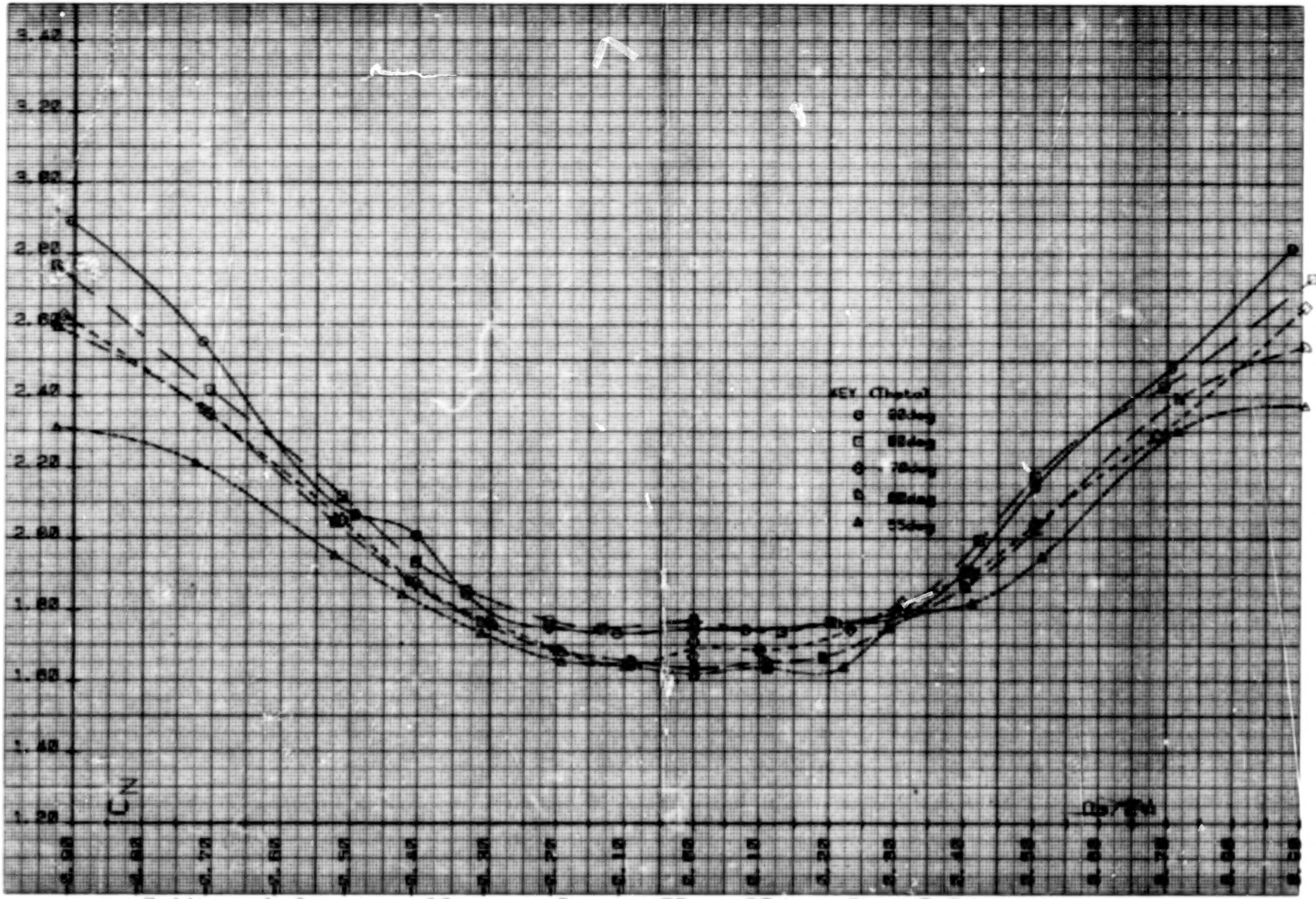


(e.) Pitching-moment coefficient, Theta= 55 to 90deg Phi=-0.0deg.

Figure 31.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V.

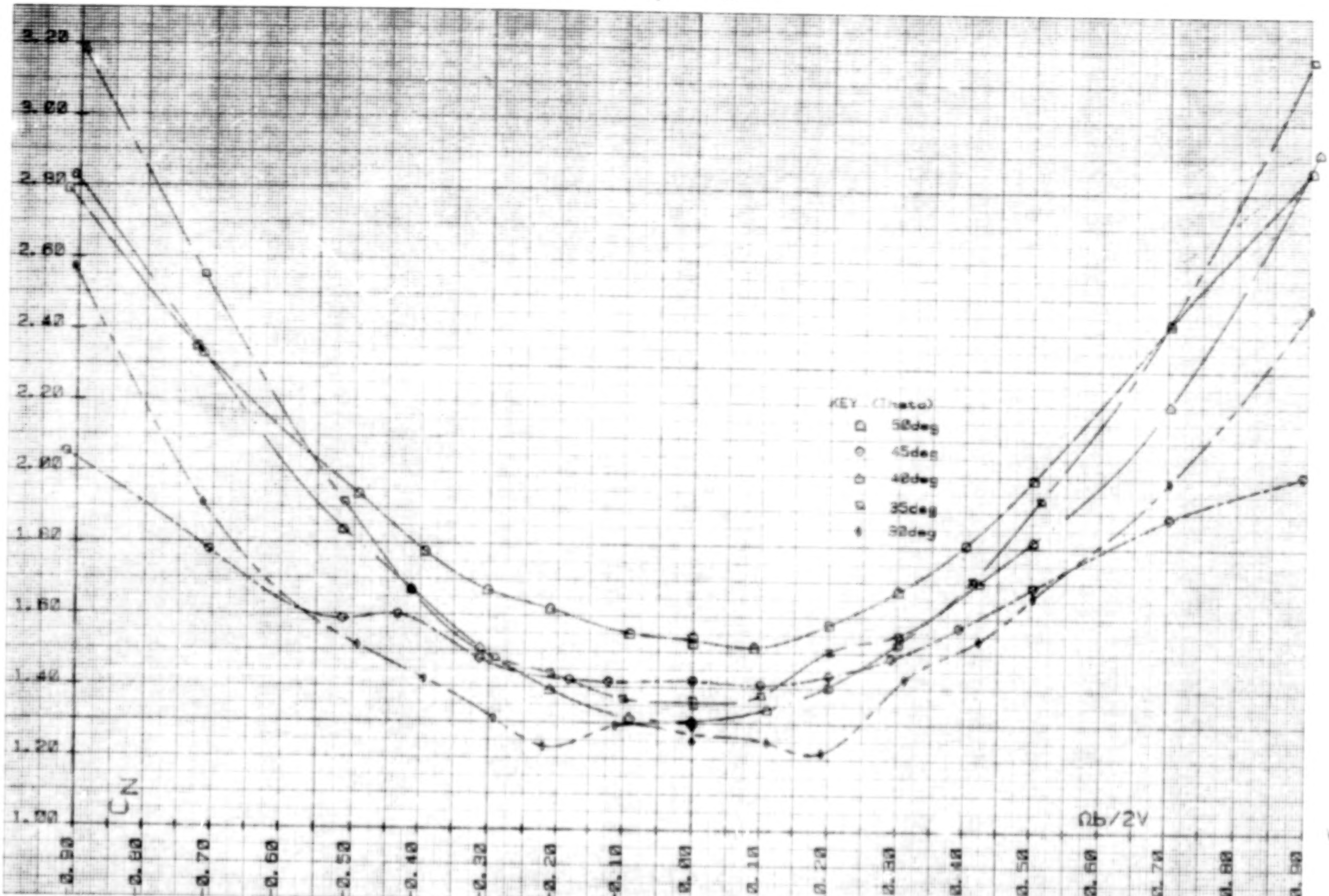


f.) Pitching-moment coefficient, Theta= 30 to 50deg Phi= 0.1deg.
Figure 31.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V.



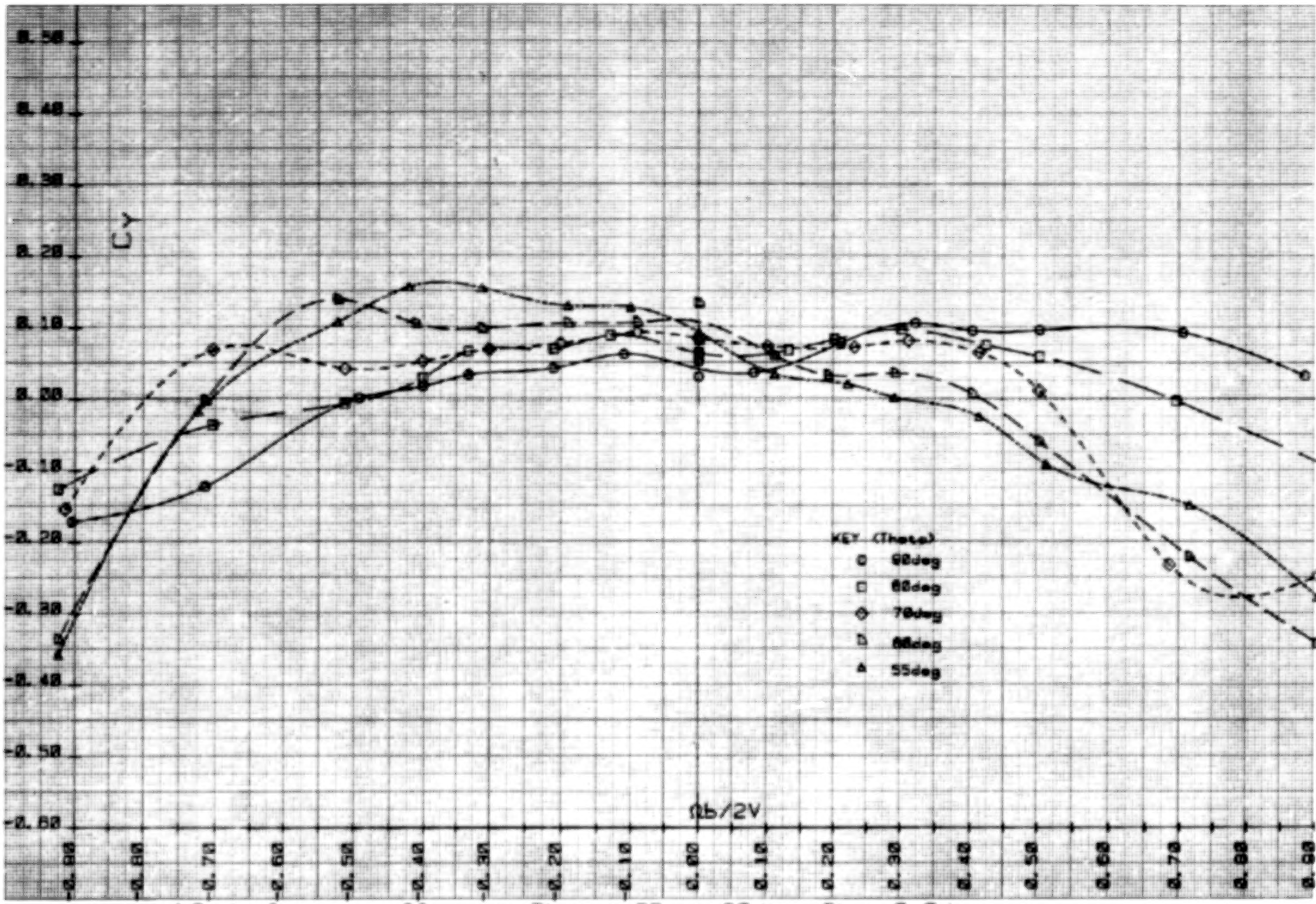
9) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 31. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V.



([illegible].) Normal-force coefficient. Theta= 30 to 50deg; Phi= 0.1deg.

Figure 31. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V.



.) Side-force coefficient, Theta= 55 to 9Ødeg: Phi=-Ø.Ødeg.

Figure 31. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V.

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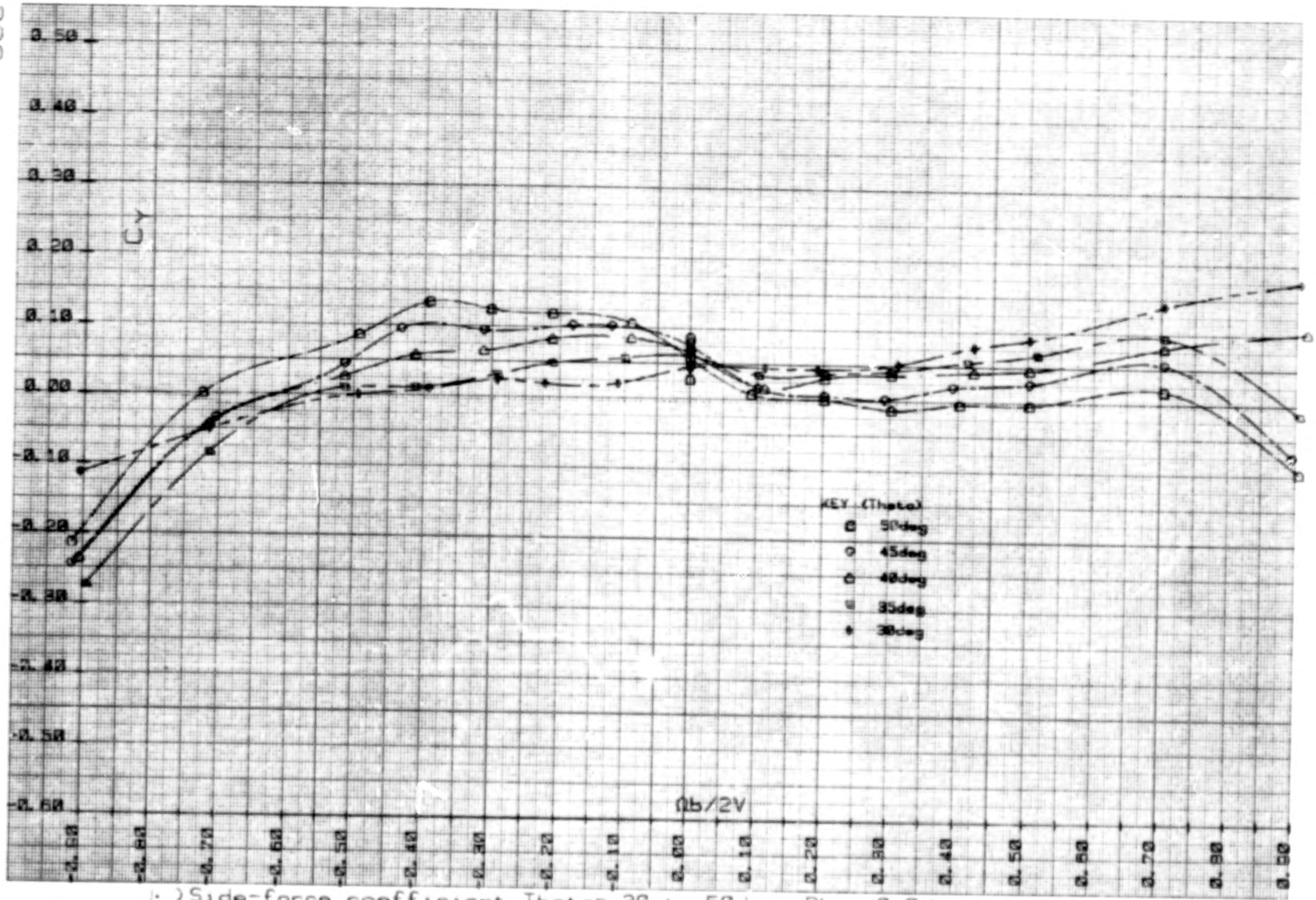
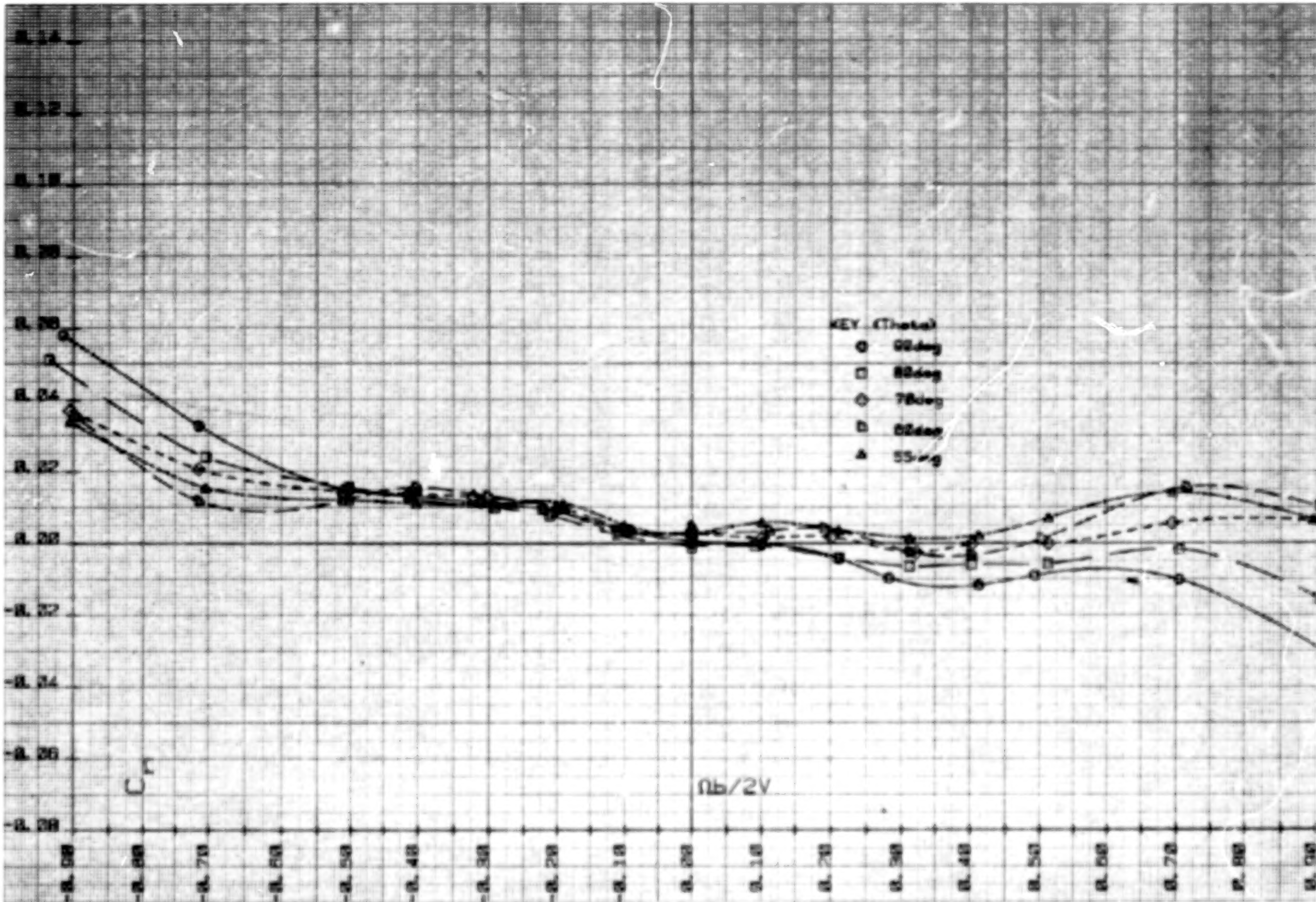


(j) Side-force coefficient. Theta= 30 to 50deg; Phi=-0.0deg.

Figure 31. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V.



a.) Yawing-moment coefficient, Theta= 55 to 92deg; Phi= 0.0deg.

Figure 32.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V-25r.

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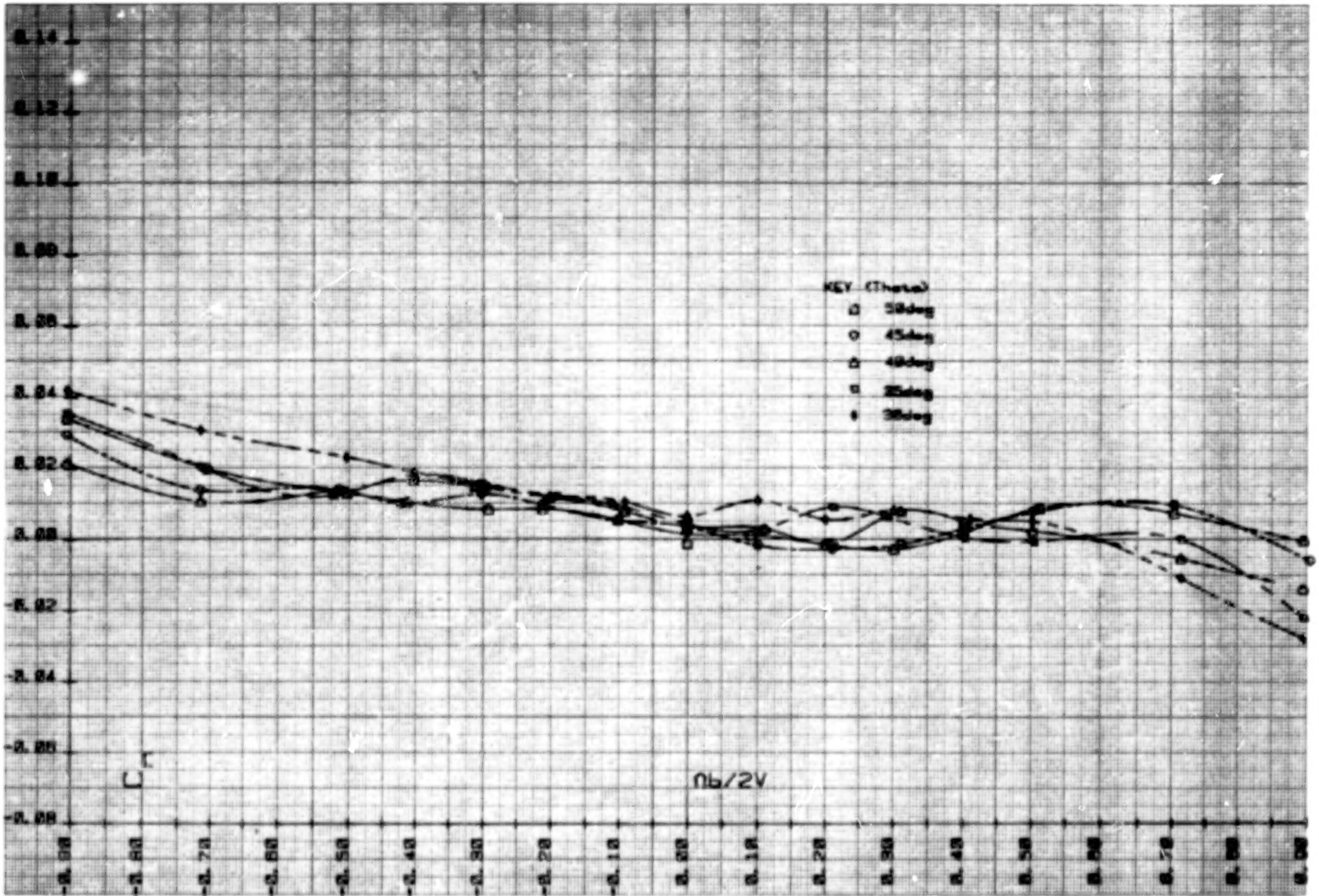
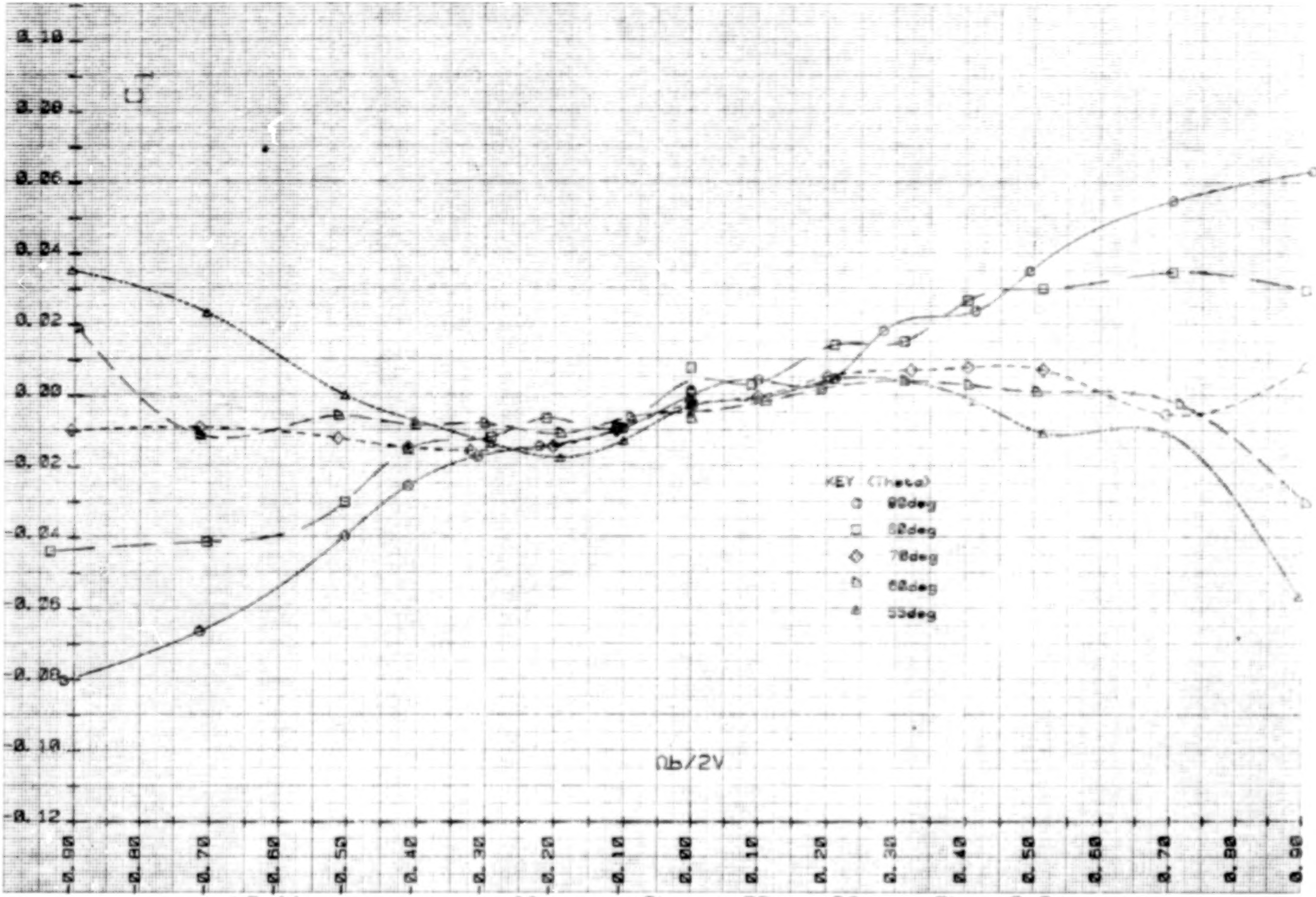


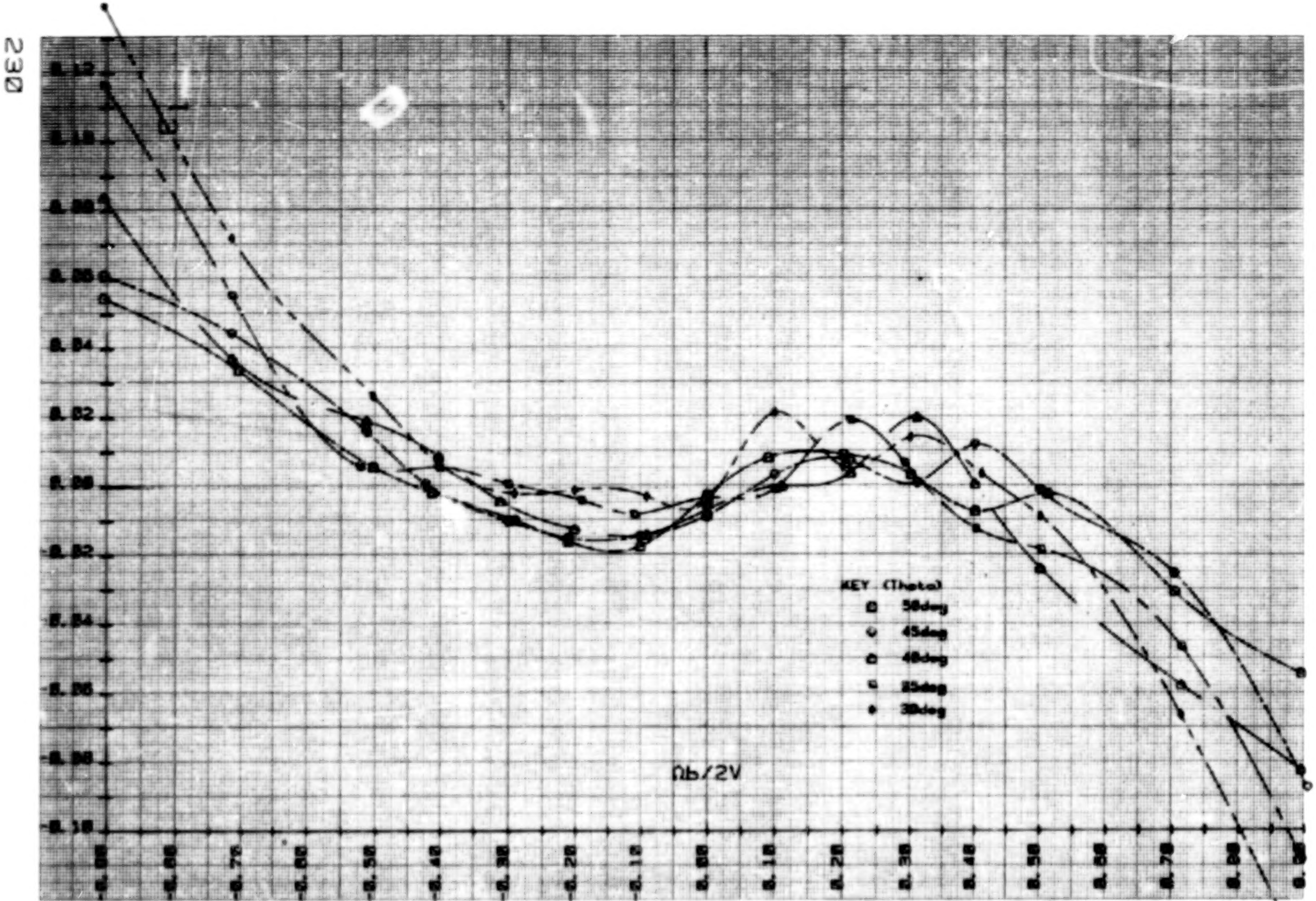
( ) Yawing-moment coefficient, Theta= 30 to 50deg; Phi= 0.0deg.

Figure 32.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V-25r.



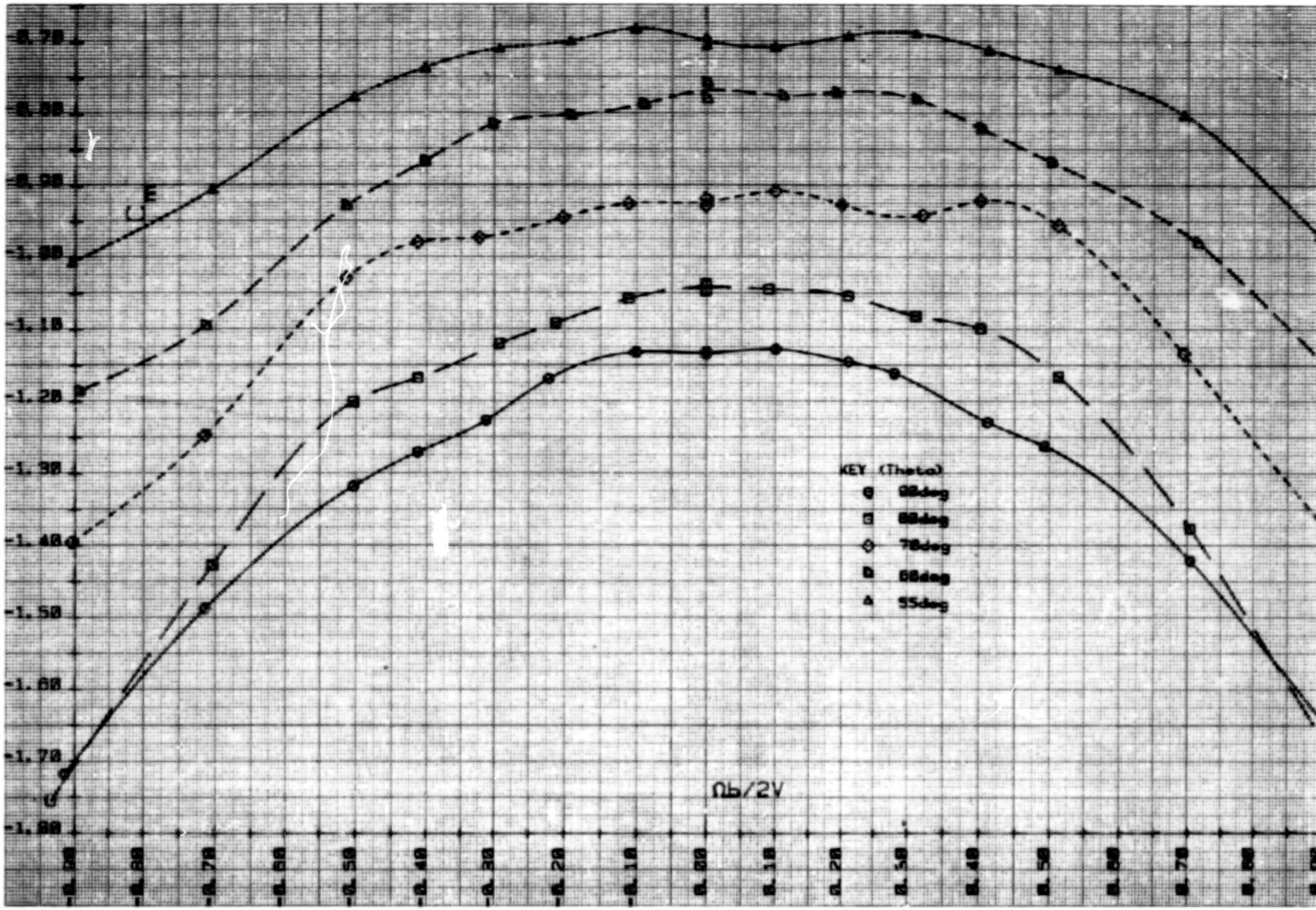
c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi= 0.0deg.

229 Figure 32.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V-25r.



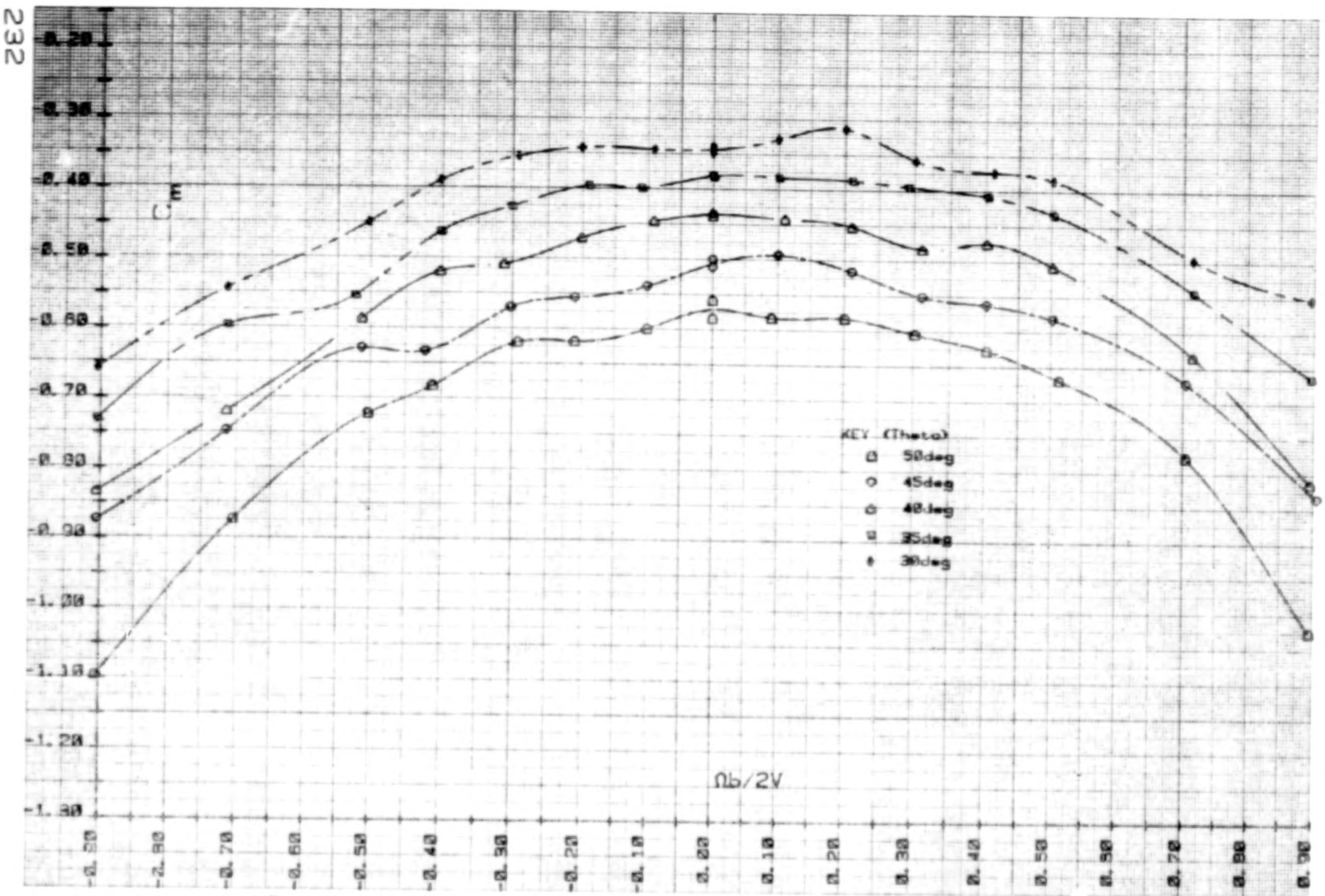
c.)Rolling-moment coefficient, Theta= 30 to 50deg; Phi= 0.0deg.

Figure 32 .-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V-25r.



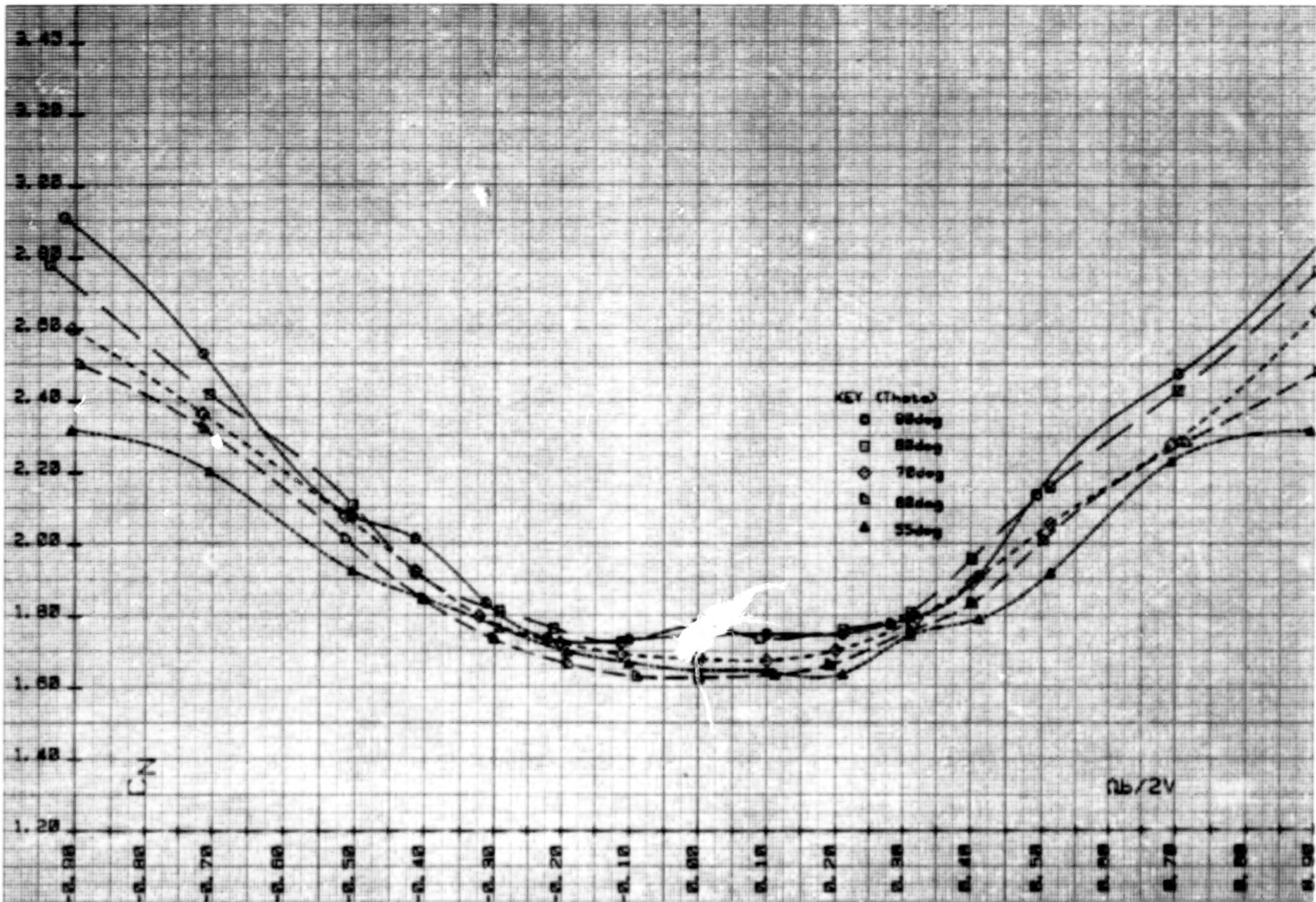
e.)Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

231 Figure 32.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V-25r.



)Pitching-moment coefficient, Theta= 30 to 50deg; Phi= 0.! eg.

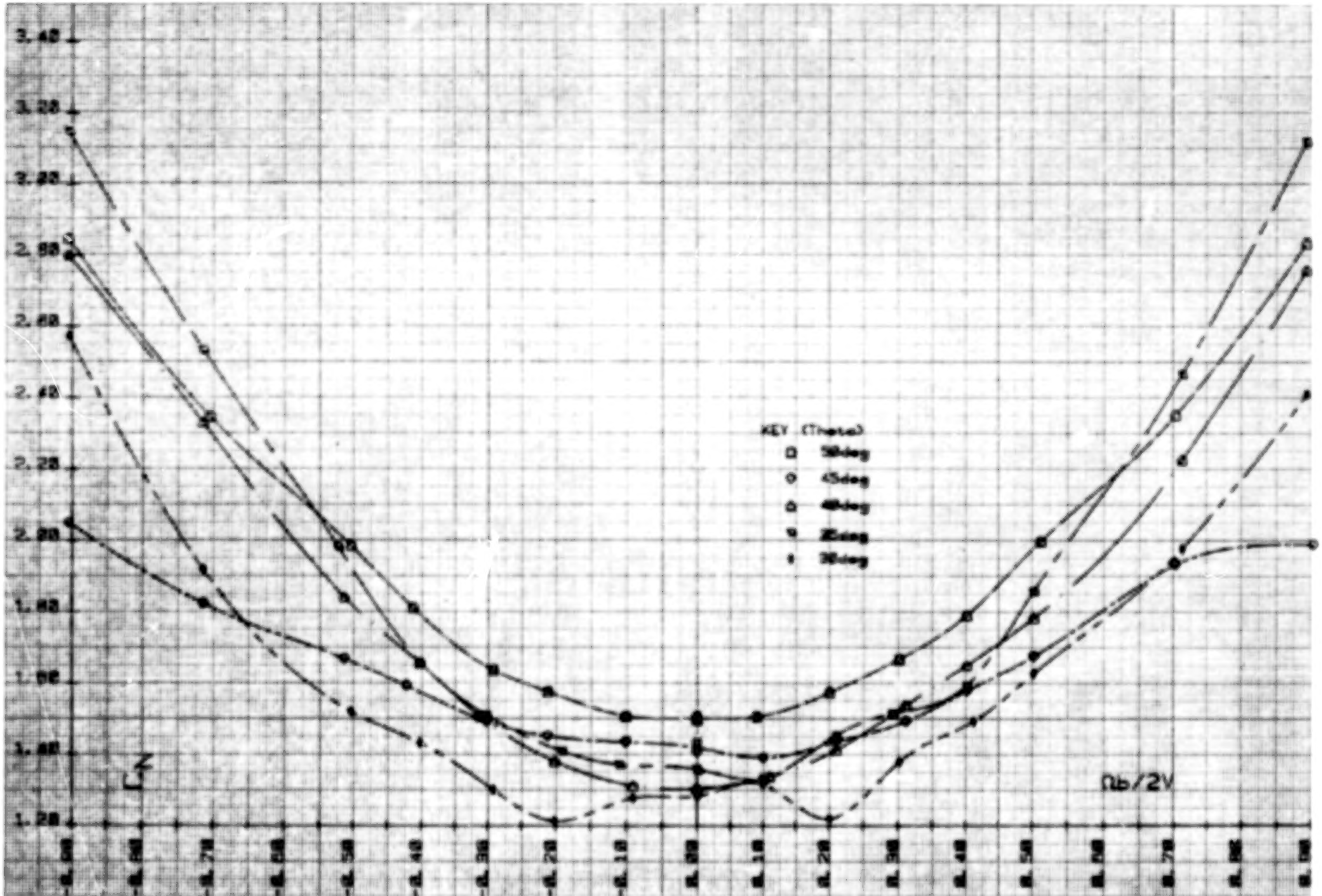
Figure 32.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V-25r.



g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

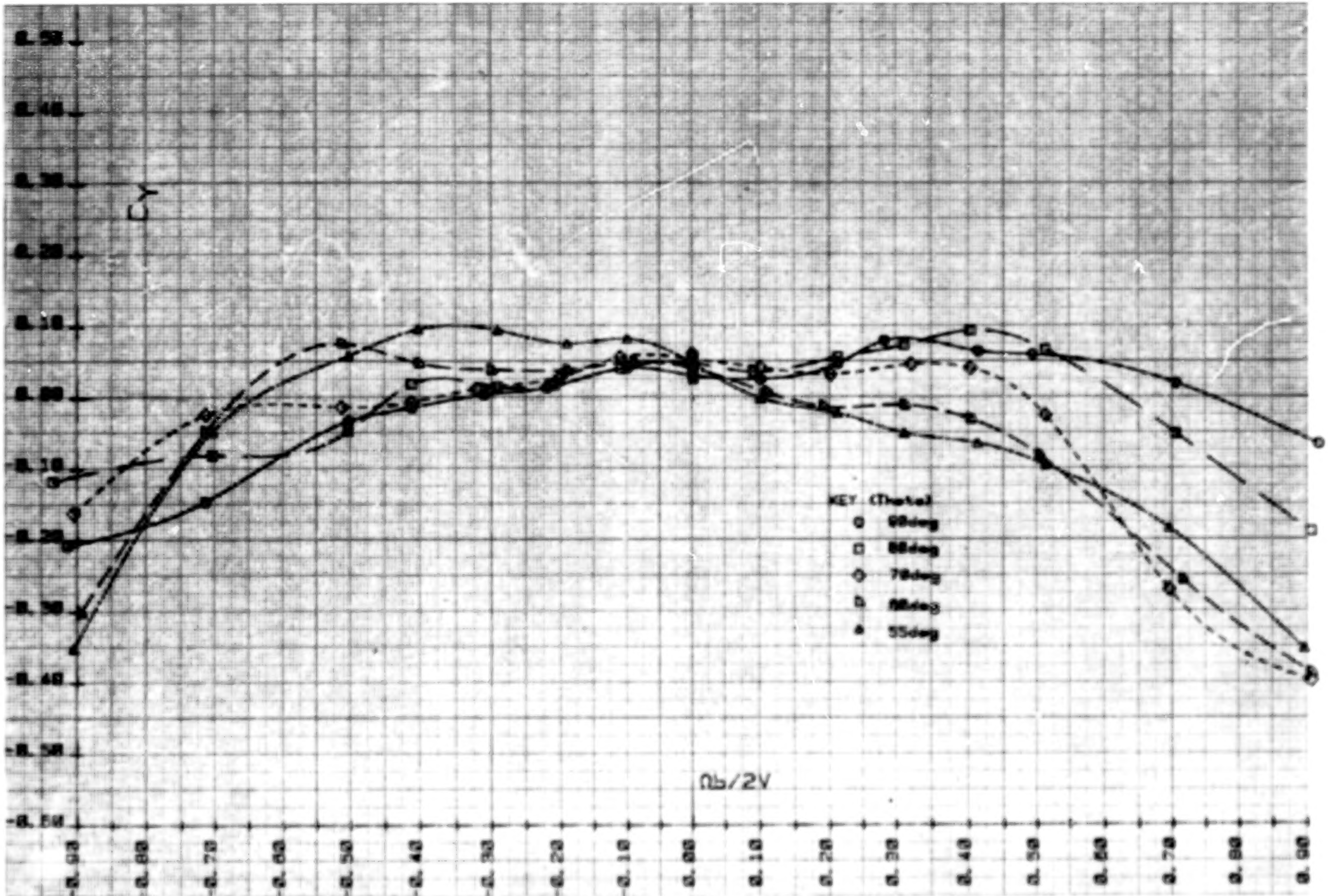
233 Figure 32.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V-25r.

234



b.) Normal-force coefficient, Theta= 30 to 50deg; Phi= 0.1deg.

Figure 32.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V-25r.



..)Side-force coefficient, Theta= 55 to 90deg; Phi= 0.0deg.

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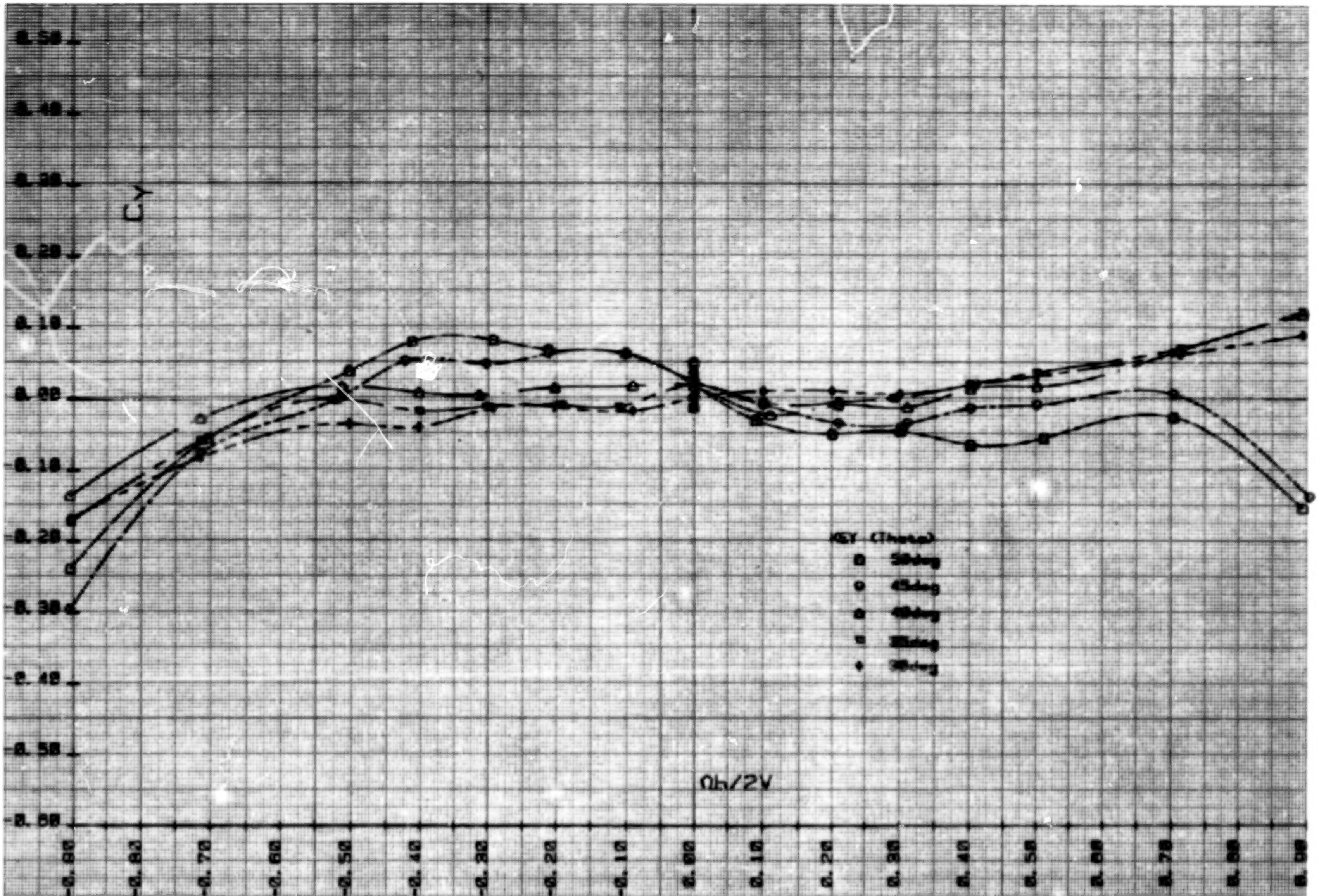
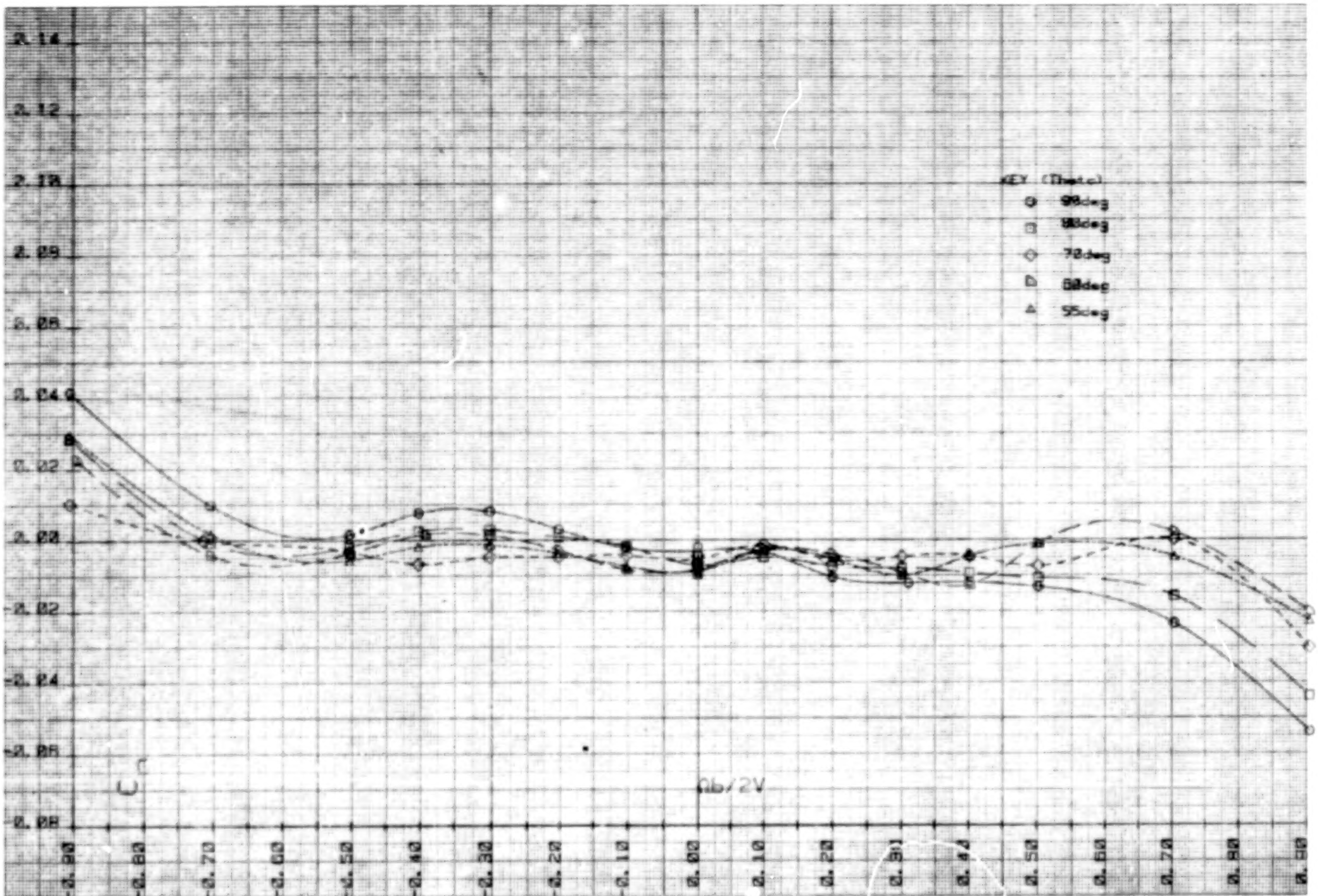
Figure 32.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration B12H3V-25r.



(j) Side-force coefficient, Theta= 30 to 50deg; Phi= 0.0deg.

Figure 32.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW2H3V-25r.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi= 0.1deg.

Figure 33.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW3H3V.

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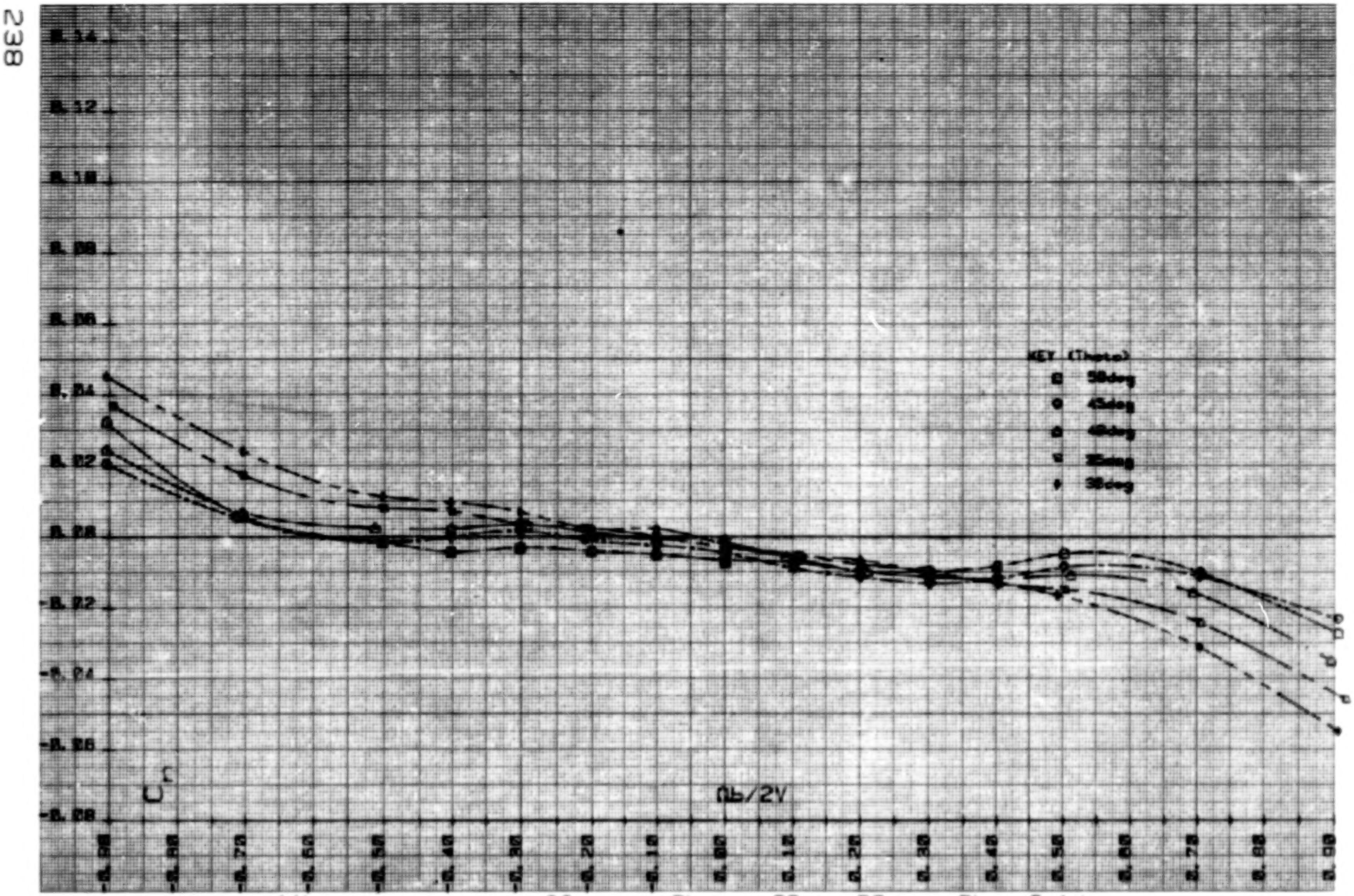
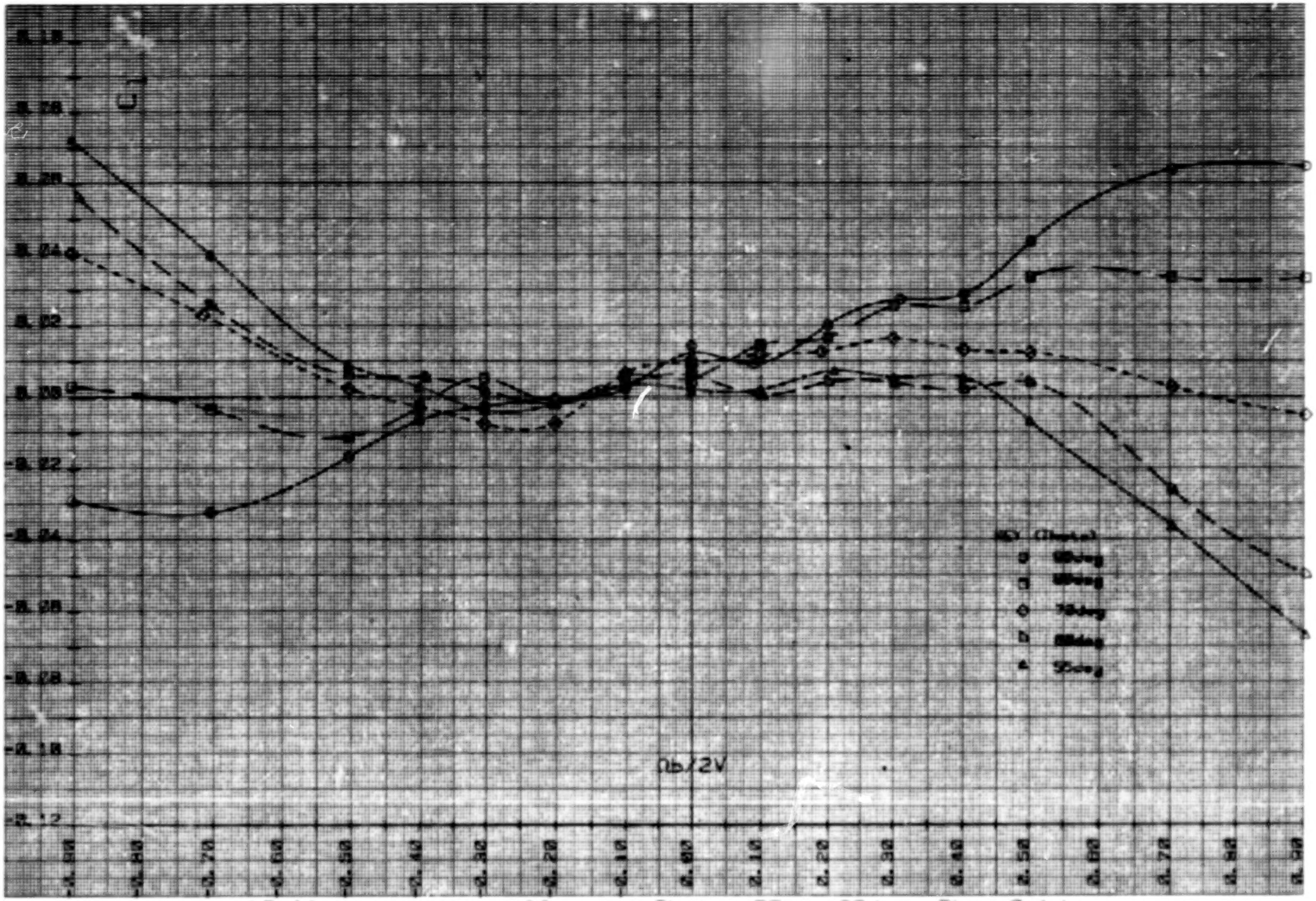


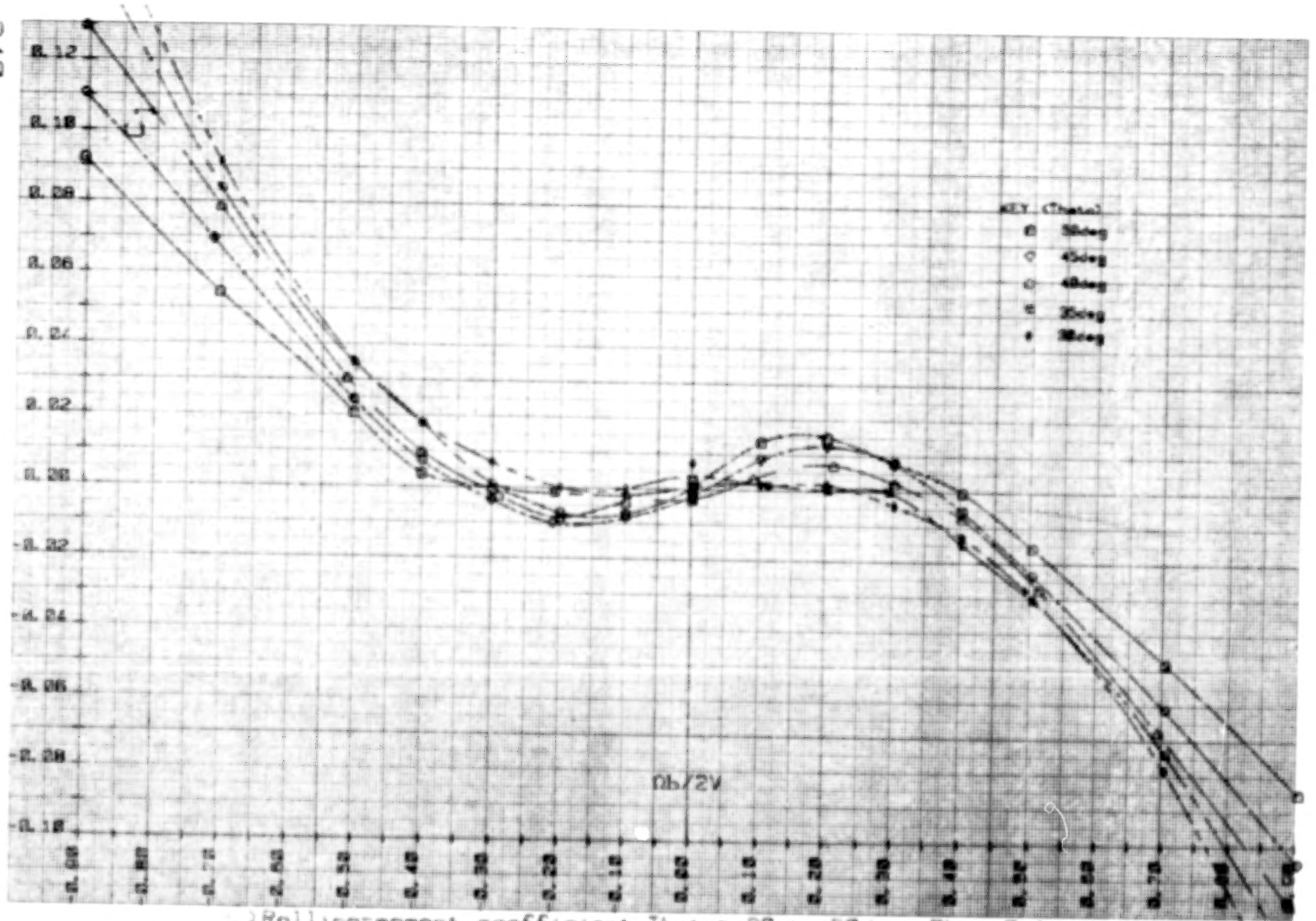
b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi= 0.1deg.

Figure 33.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW3H3V.



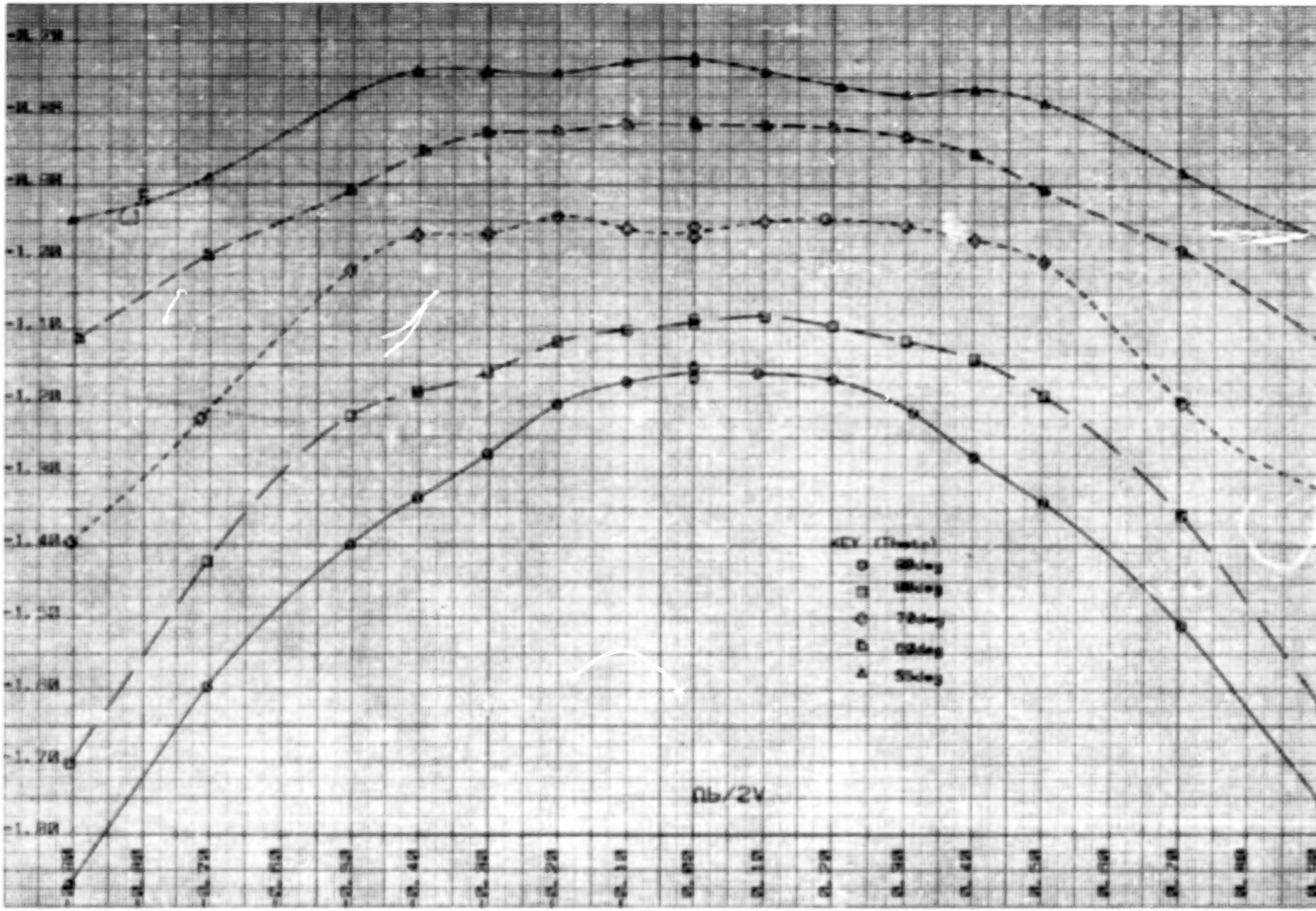
c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi= 0.1deg.

Figure 33. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW3H3V.



)Rolling-moment coefficient, Theta= 30 to 50deg; Phi= 0.1deg.

Figure 33.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW3H3V.



e.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

Figure 33.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW3H3V.

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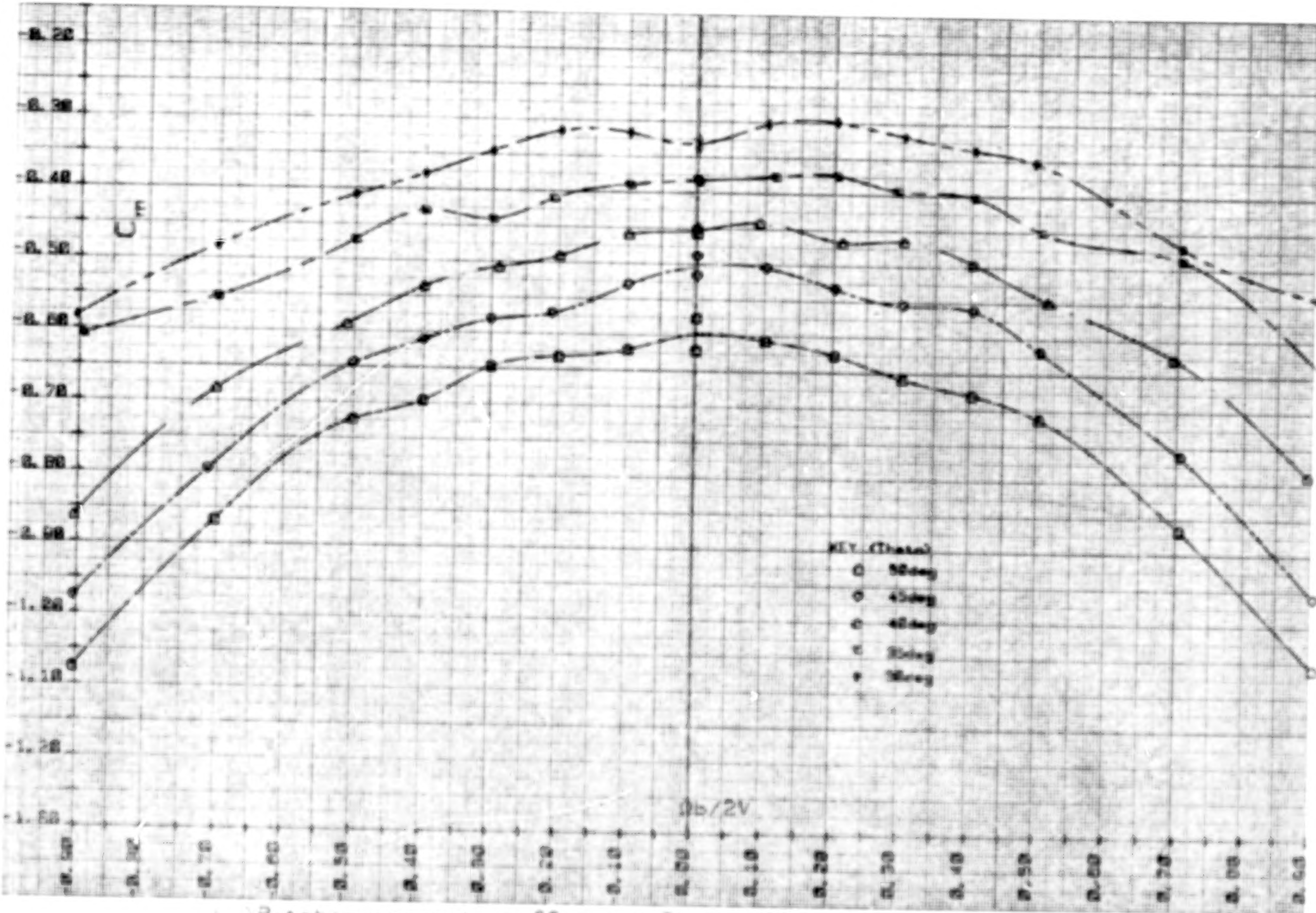
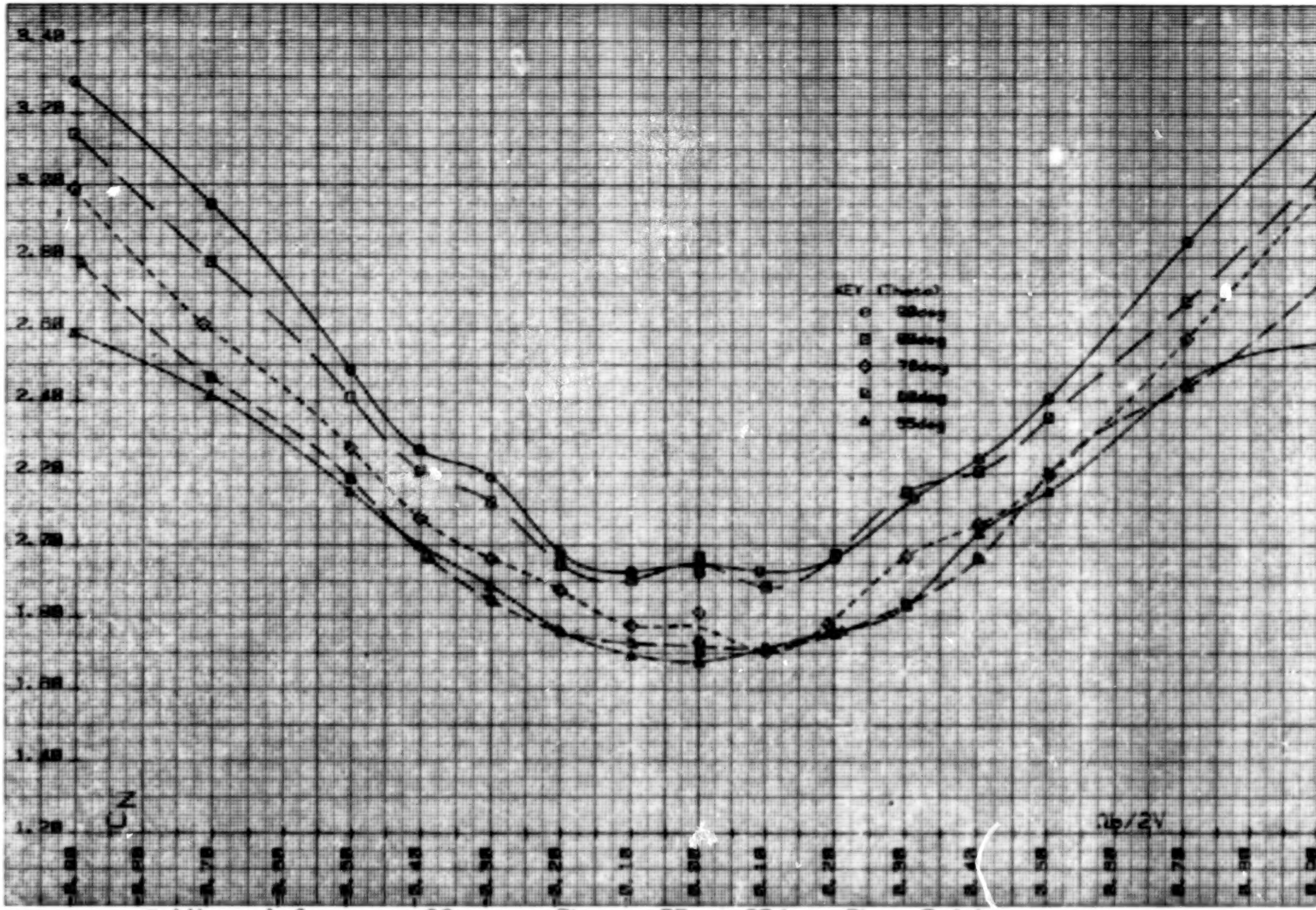


(...) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.5deg.

Figure 33. - Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW3H3V.



9·) Normal-force coefficient, Theta= 55 to 90deg; Phi= 0.1deg.

Figure 33.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW3H3V.

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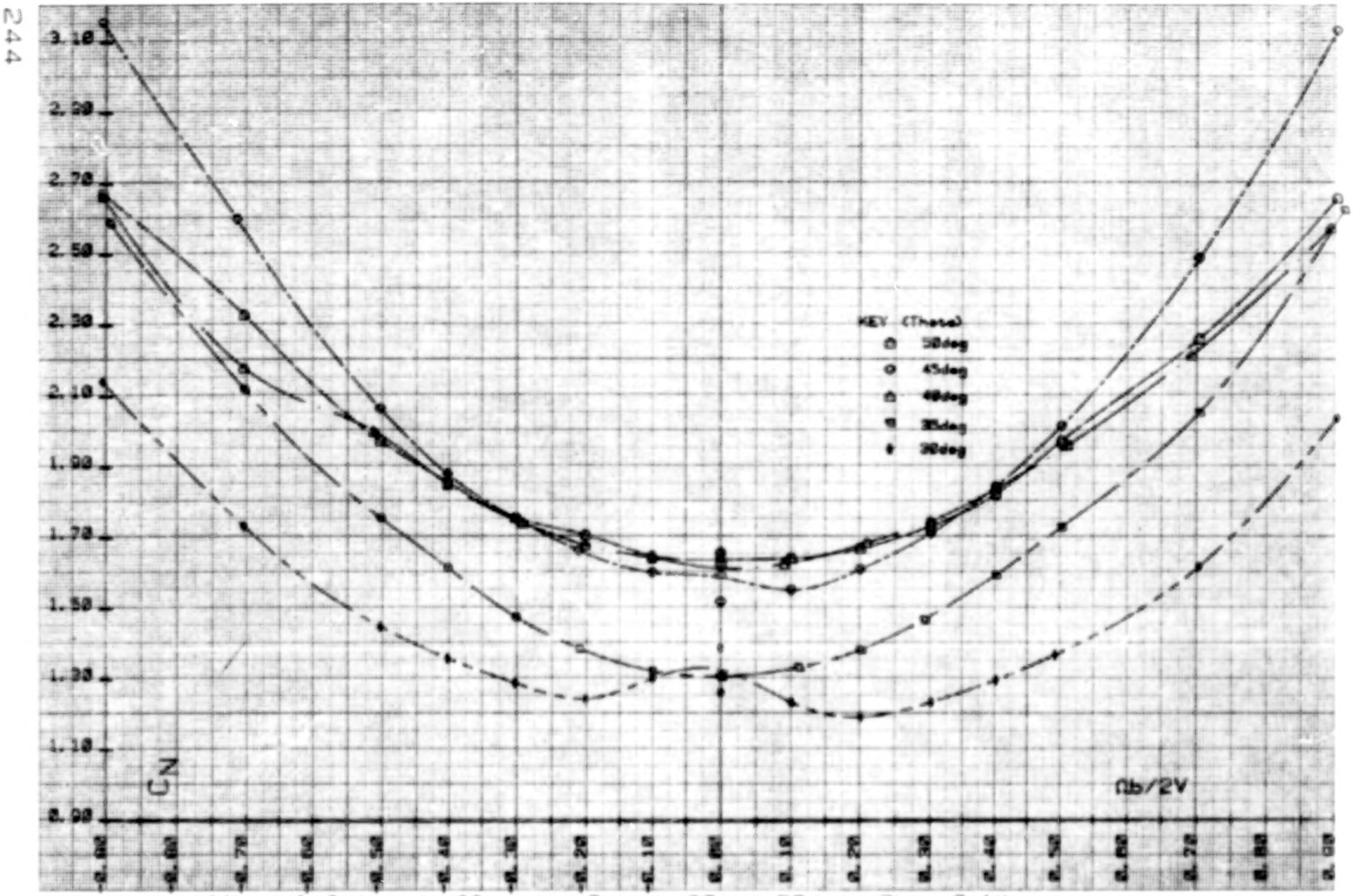
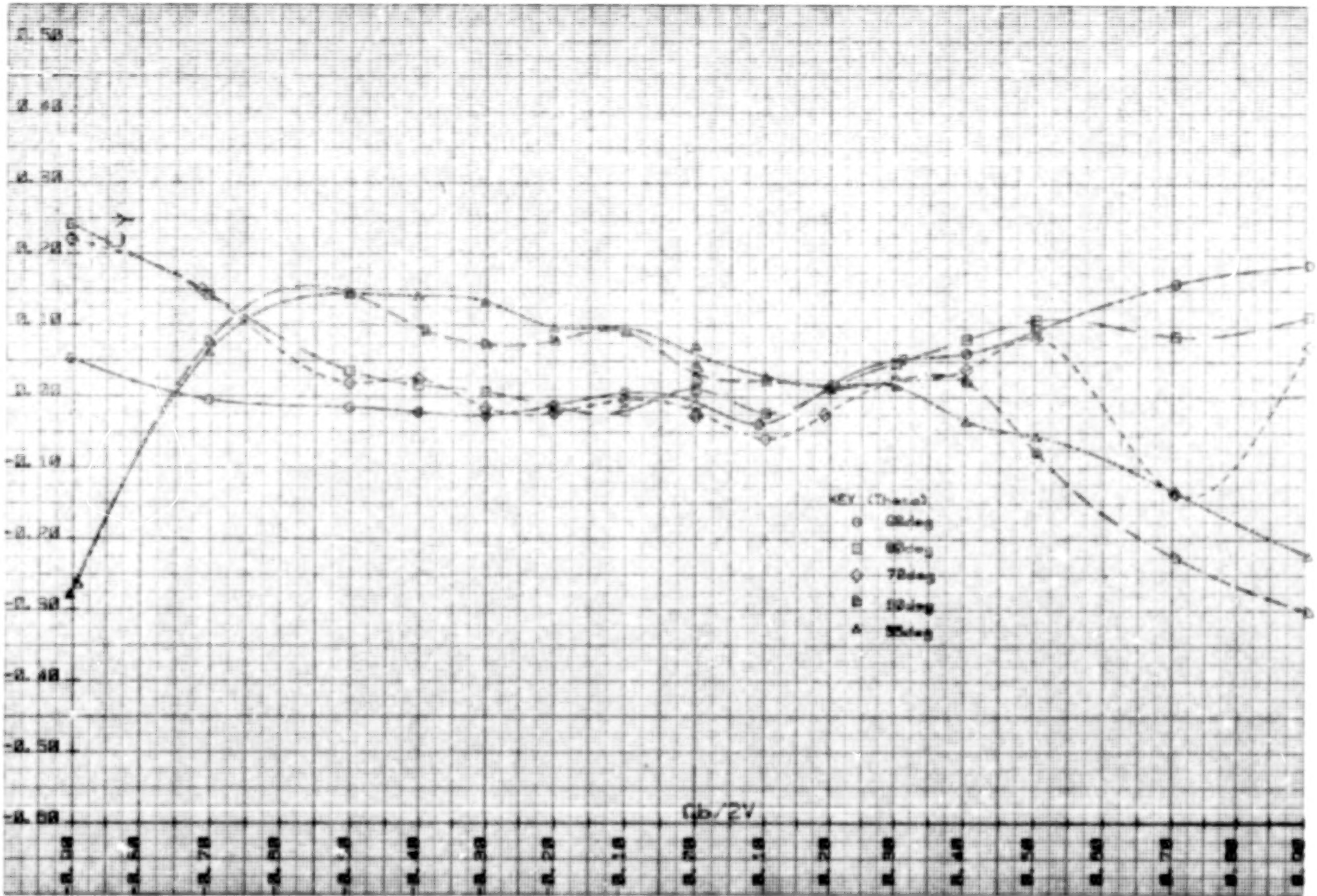


h.) Normal-force coefficient, Theta= 30 to 50deg; Phi= 0.1deg.

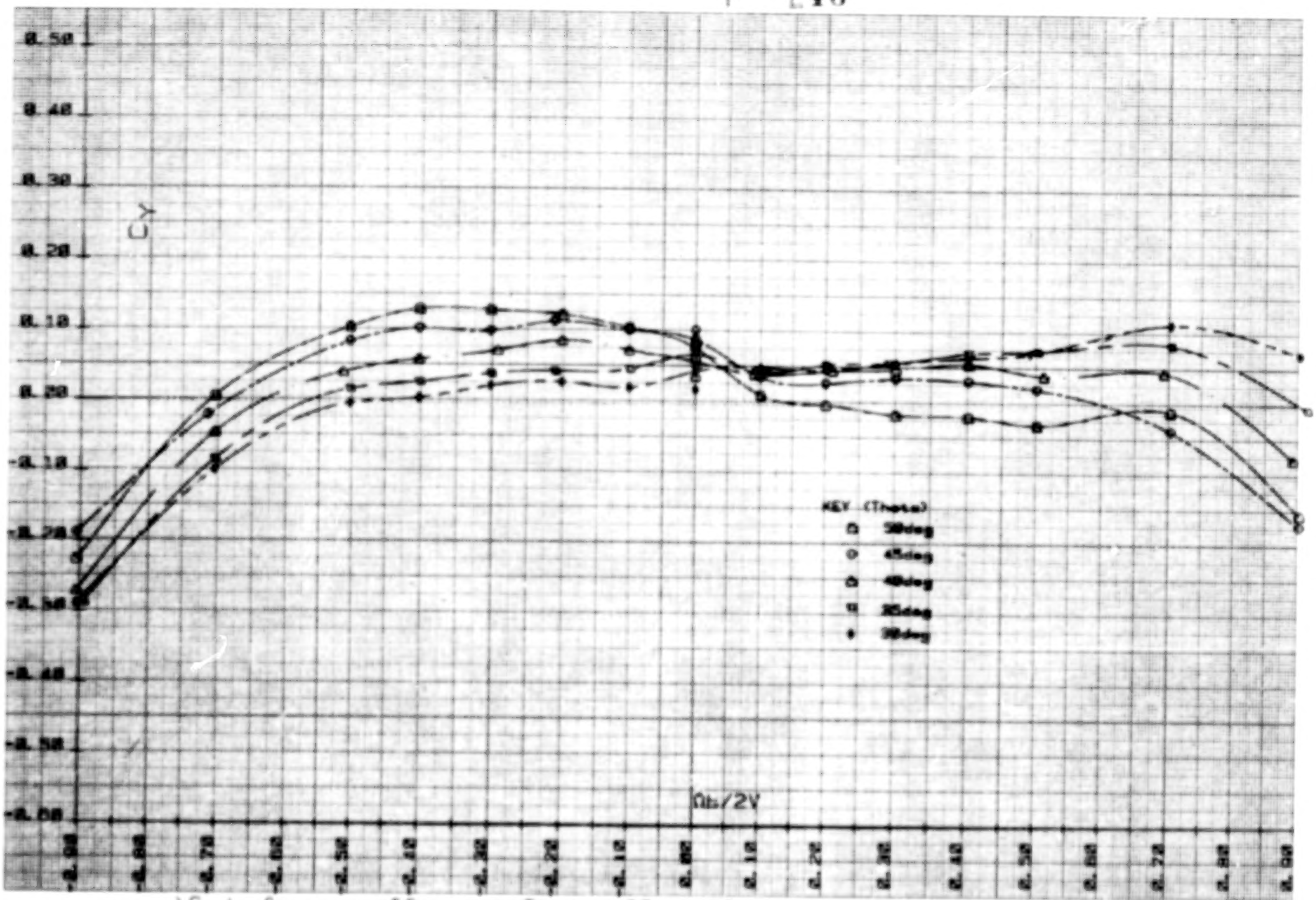
Figure 33.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW3H3V.



.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

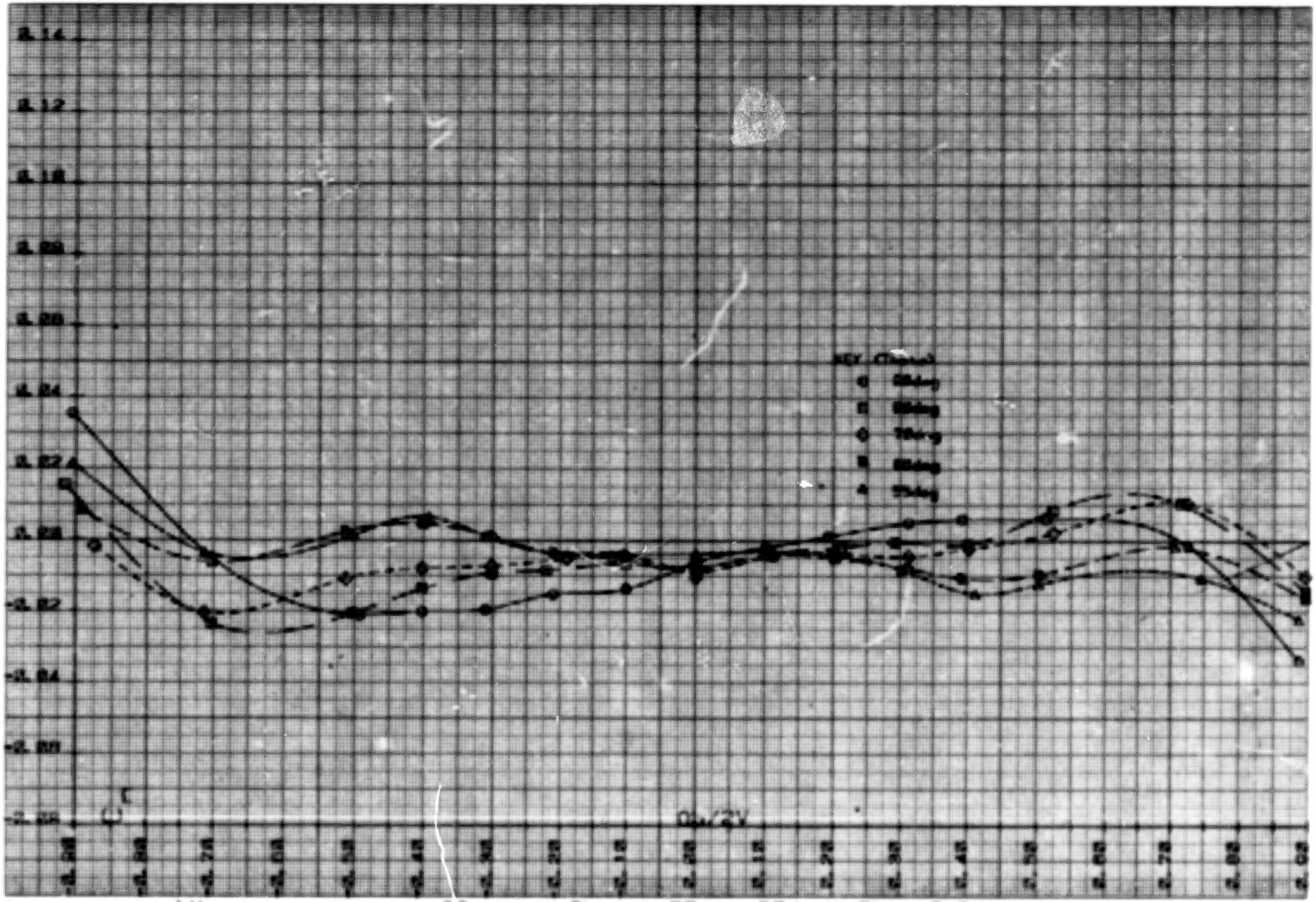
Figure 33. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW3H3V.

245



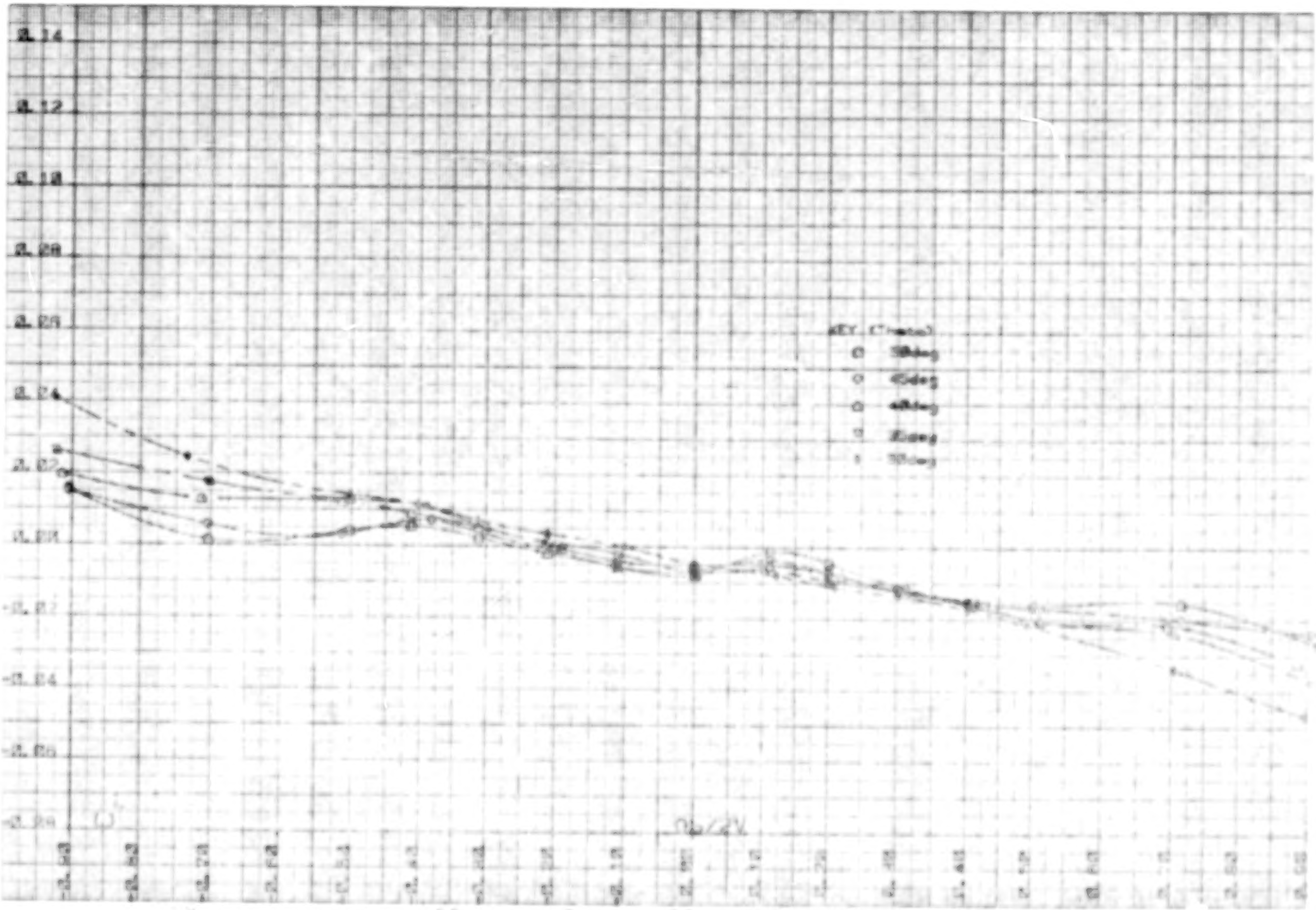
.) Side-force coefficient, Theta= 30 to 50deg; Phi= 0.1deg.

Figure 33.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW3H3V.



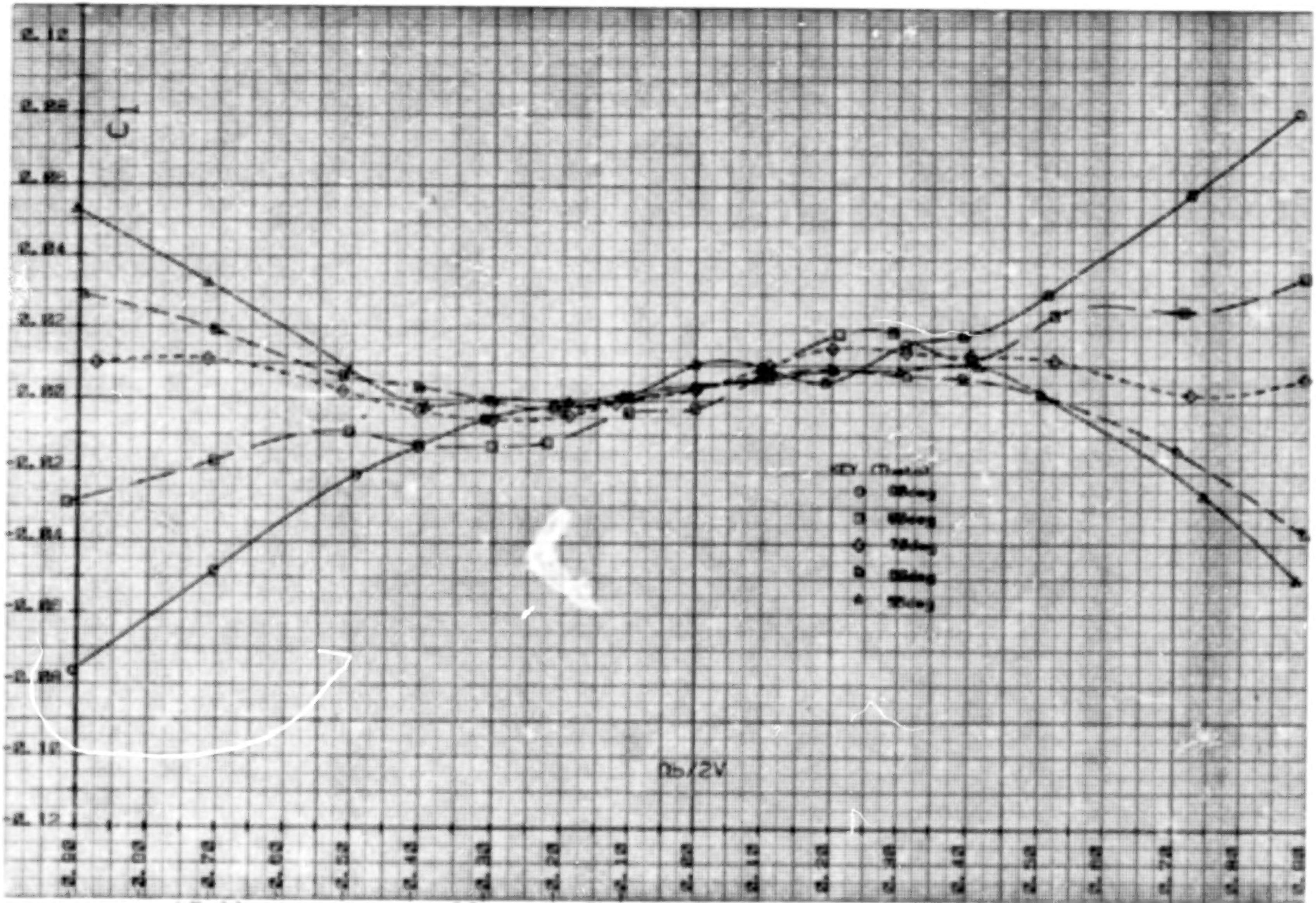
a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 34.-Effect of rotation rate and pitch and r ll attitude angles on aerodynamic characteristics for configuration BW1H4V.



(?) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 34.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BWIH4V.



c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.6deg.

Figure 34. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V.

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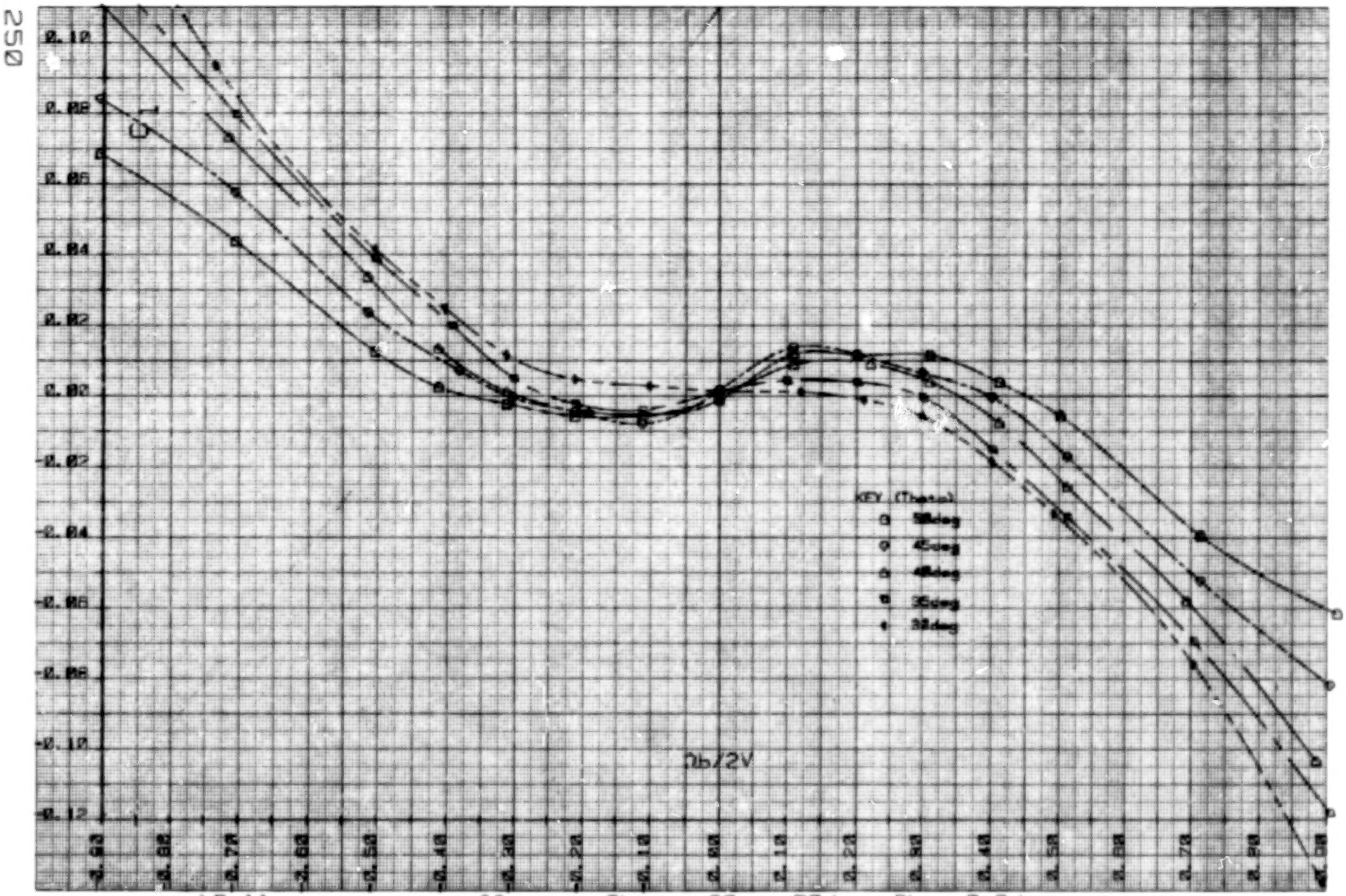
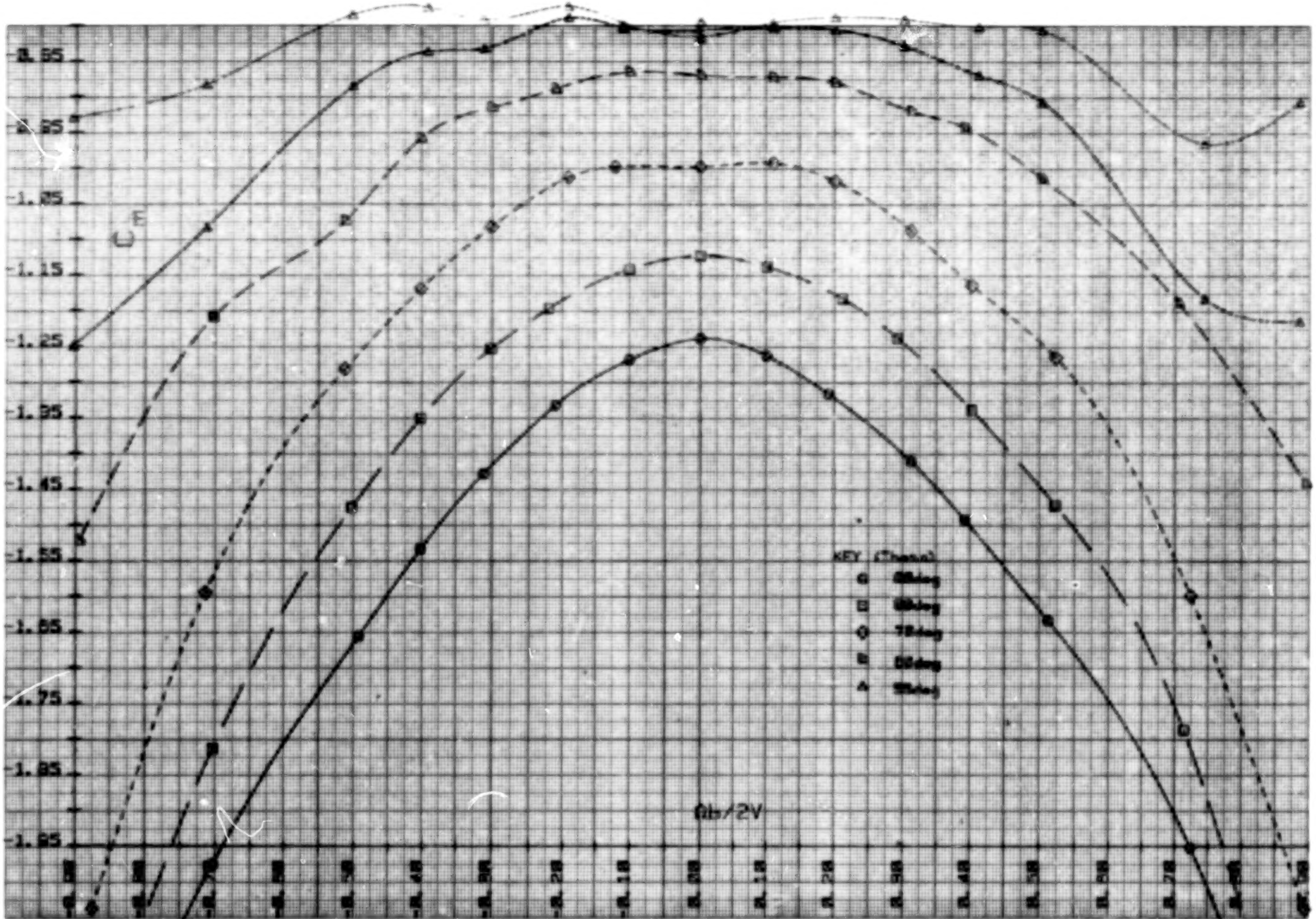


d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

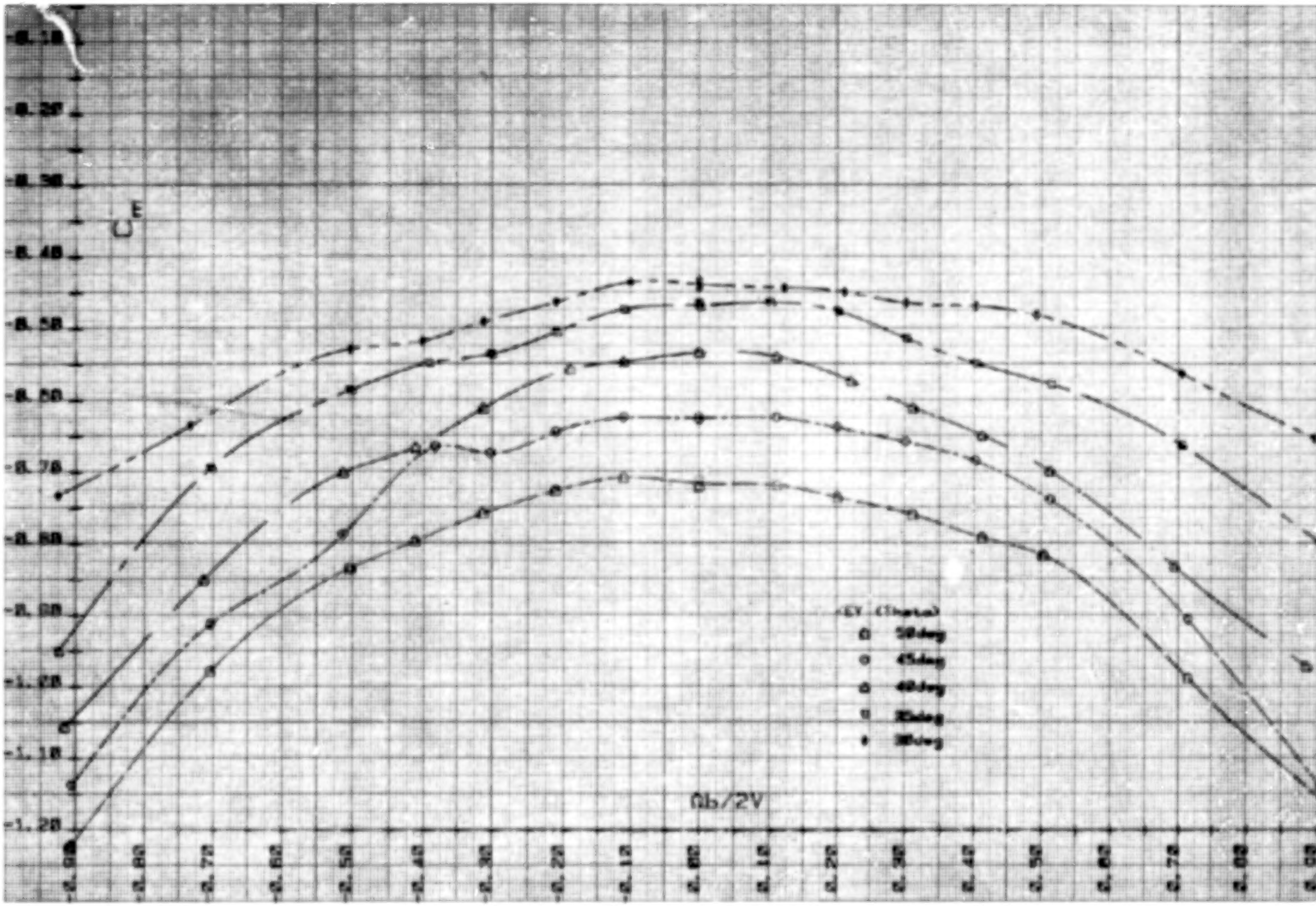
Figure 34. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V.



e.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.6deg.

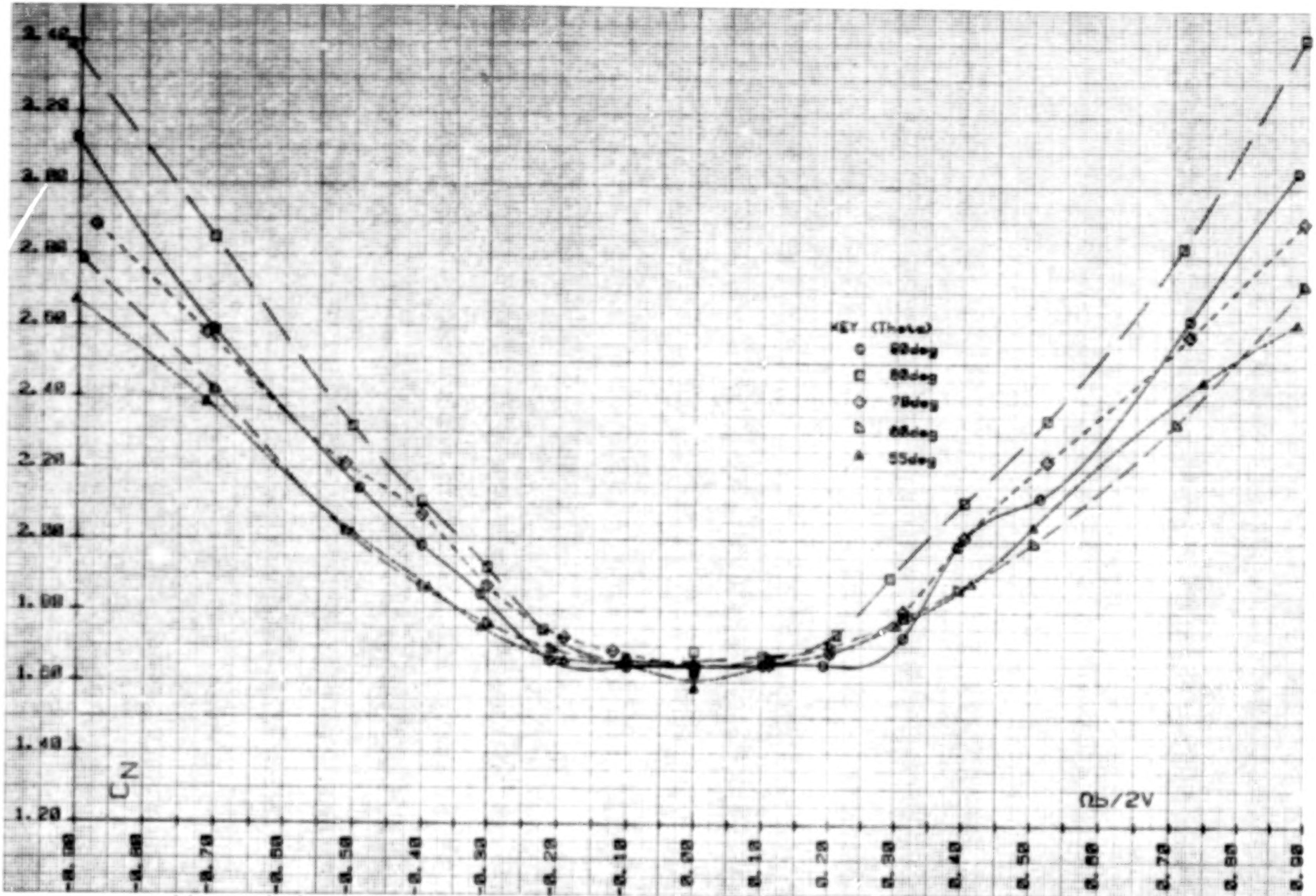
Figure 34.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V.

252



(…)Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

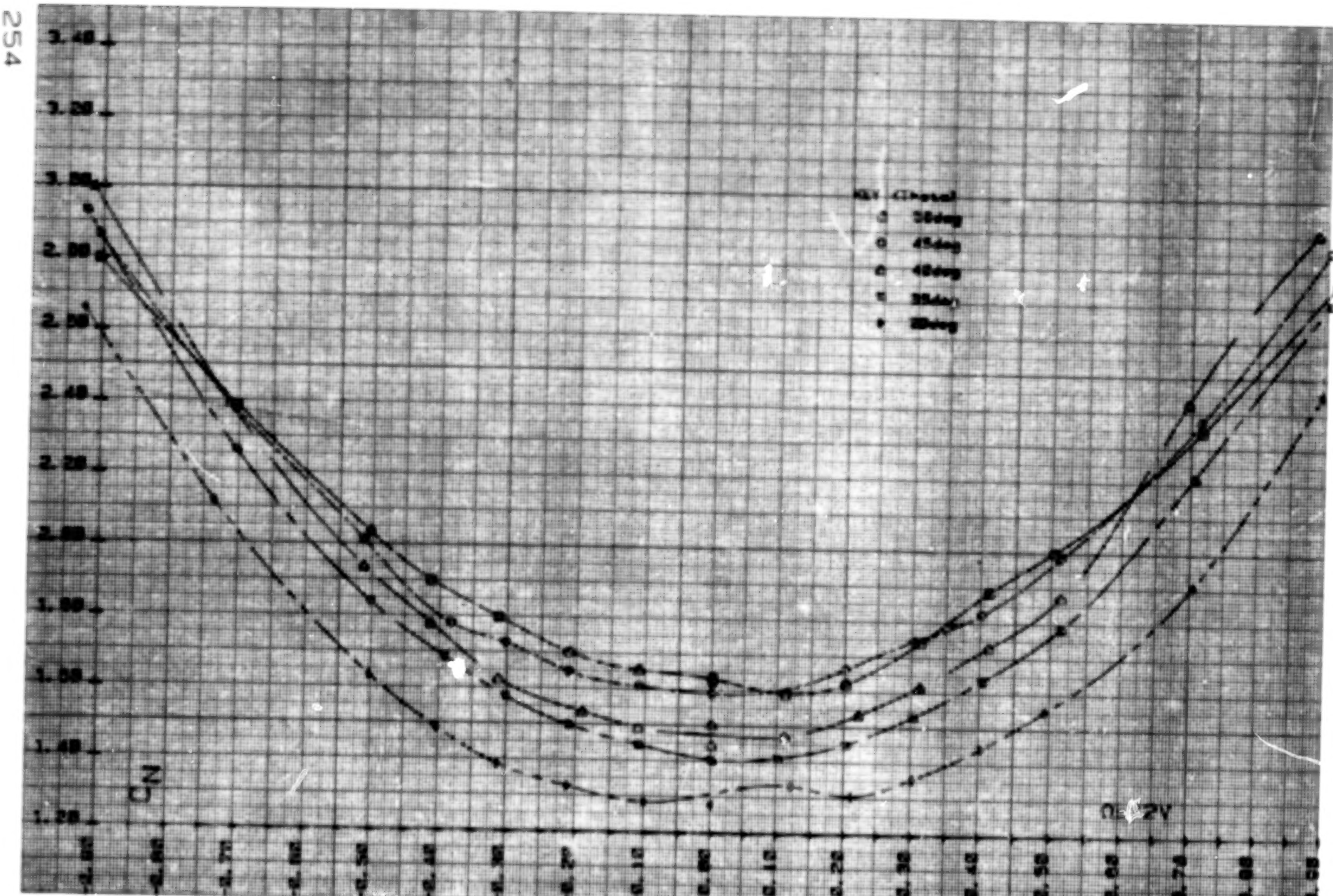
…igure 34. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V.



(.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.6deg.

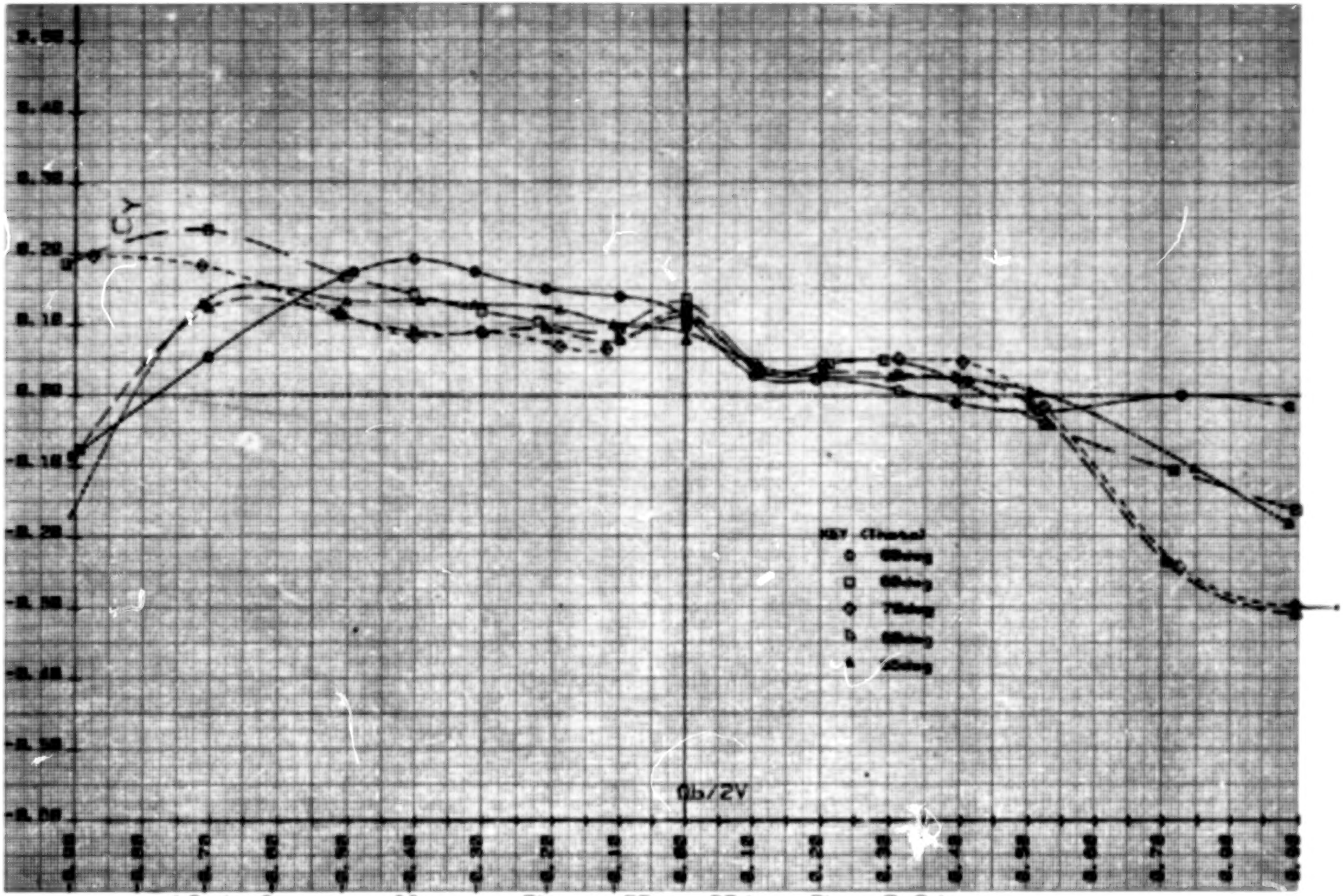
Figure 34.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V.

253



h.) Normal-force coefficient. Theta= 30 to 50deg; Phi=-0.2deg.

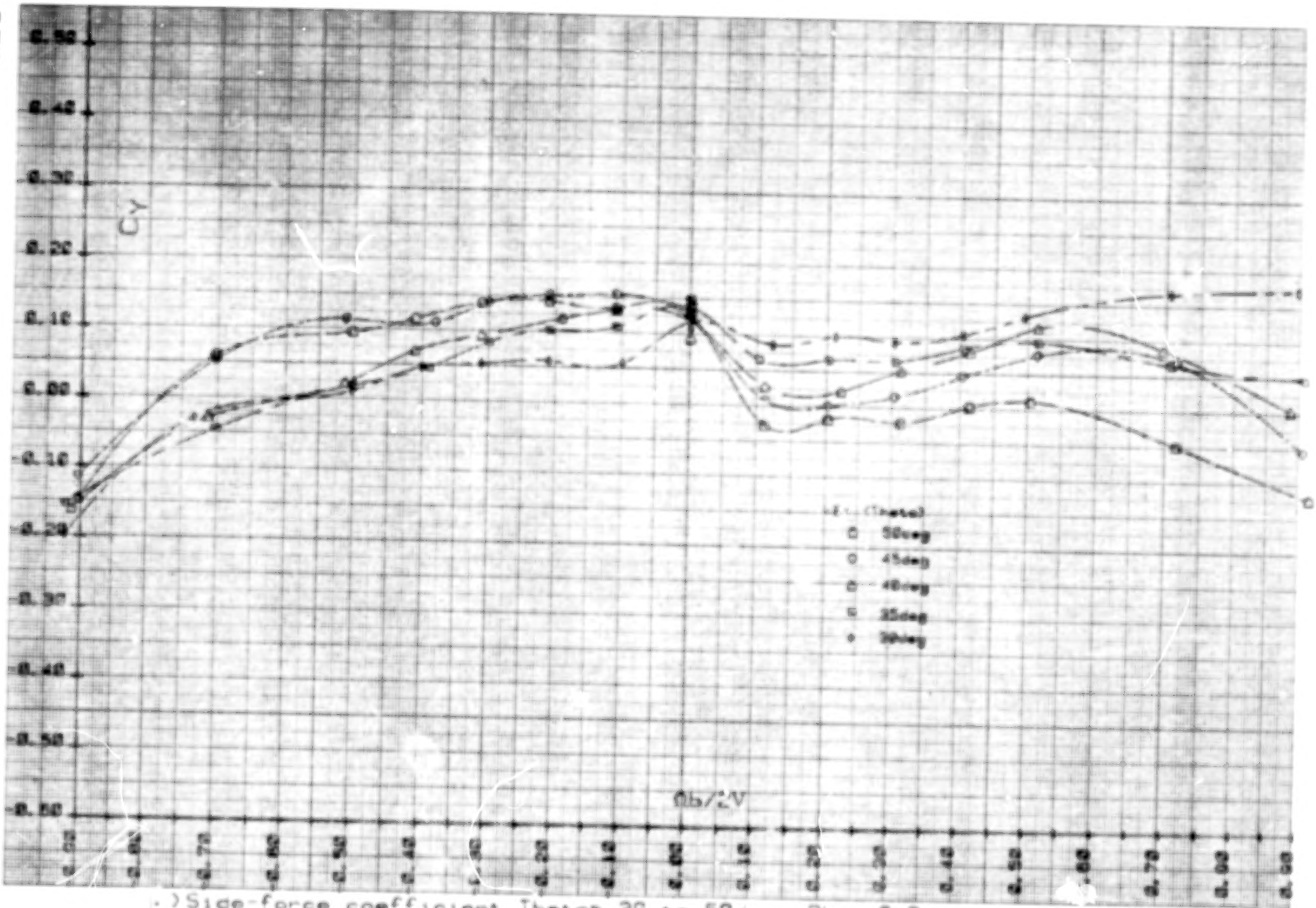
Figure 34.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V.



a.)Side-force coefficient, Theta= 55 to 90deg: Phi=-0.3deg.

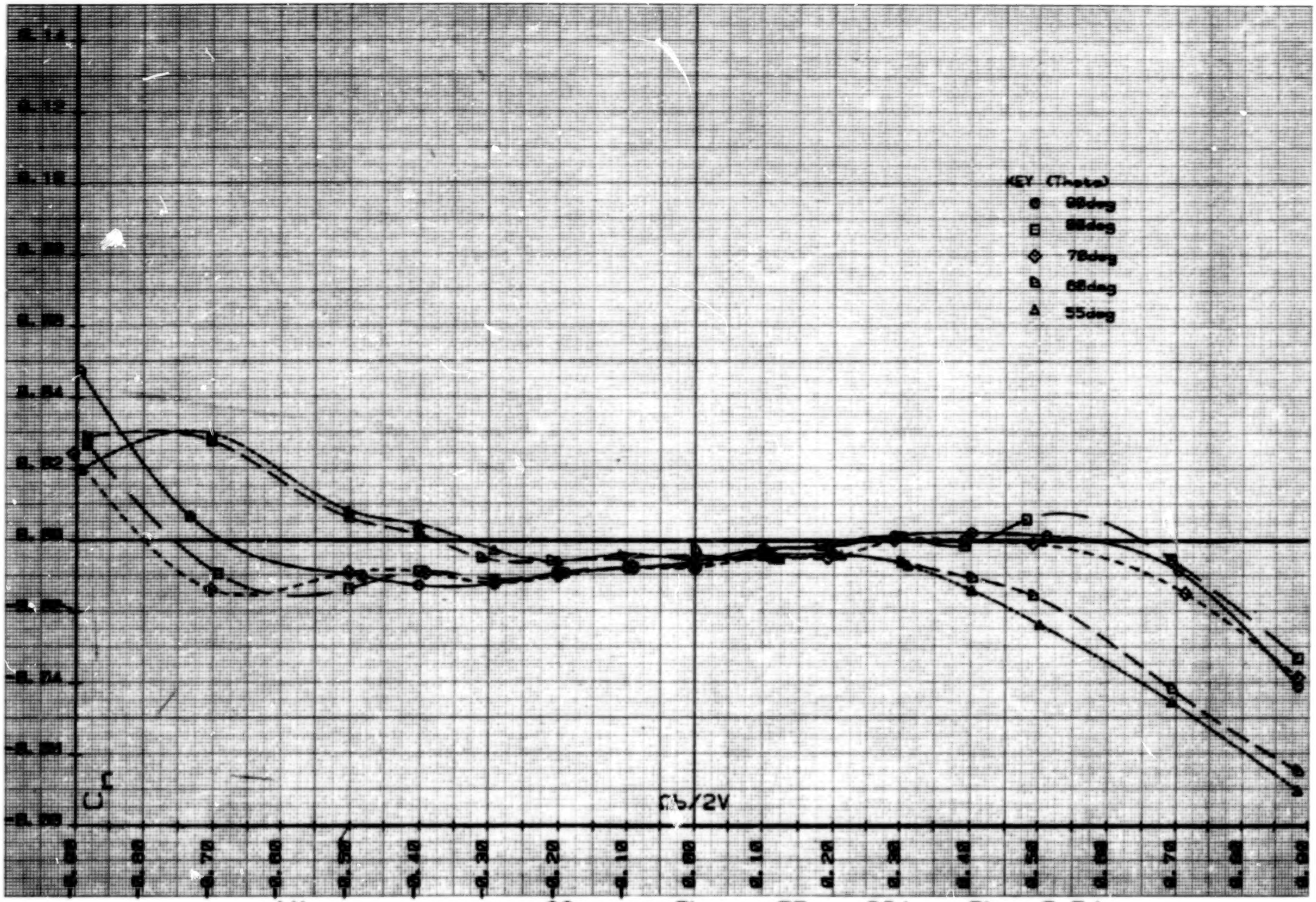
Figure 34.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V.

256



j.) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

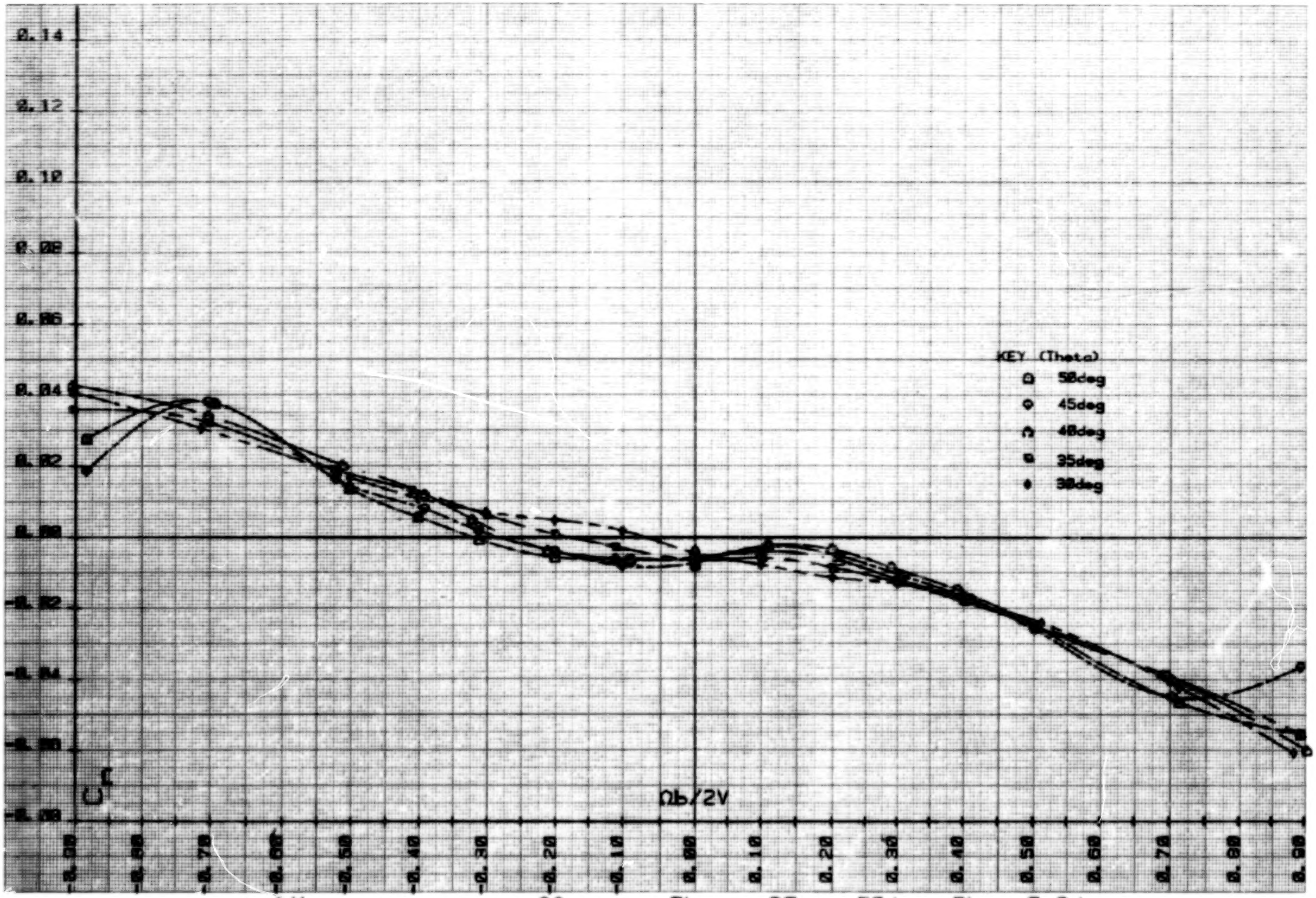
Figure 34.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.5deg.

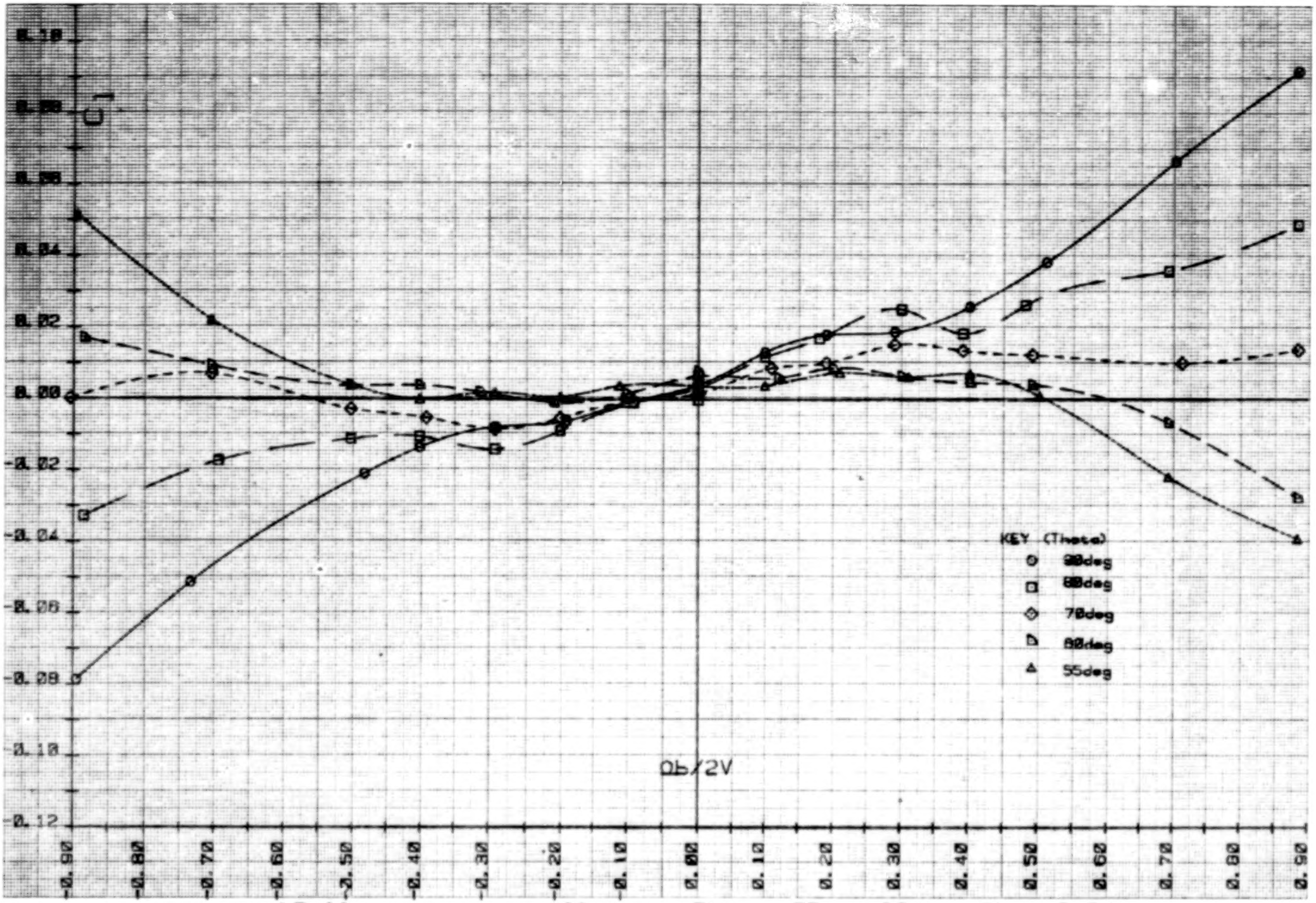
Figure 35.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+C.

257



b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

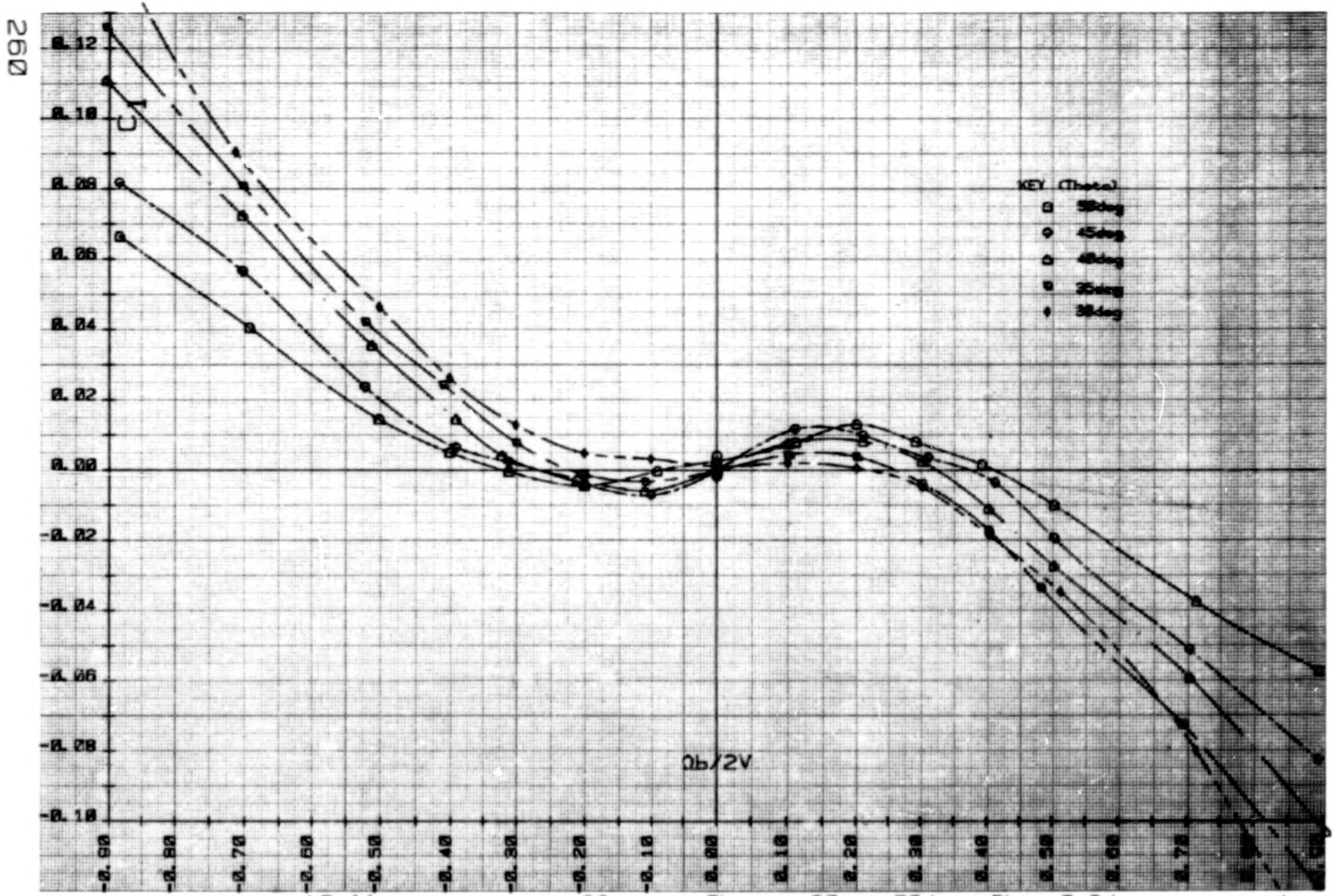
Figure 35.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+C.



c.) Rolling-moment coefficient. Theta= 55 to 90deg; Phi=-0.2deg.

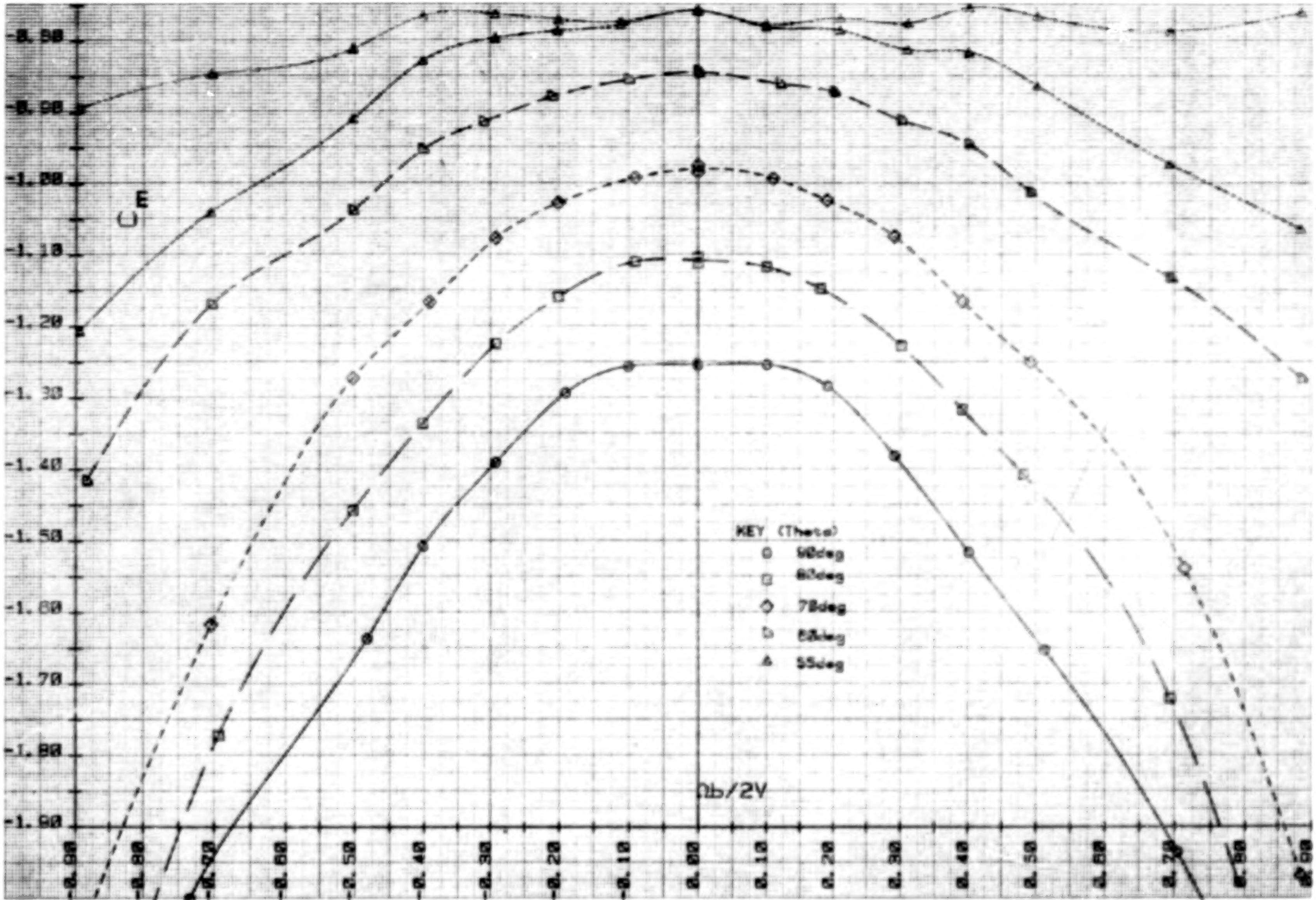
Figure 35.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+C.

259



d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

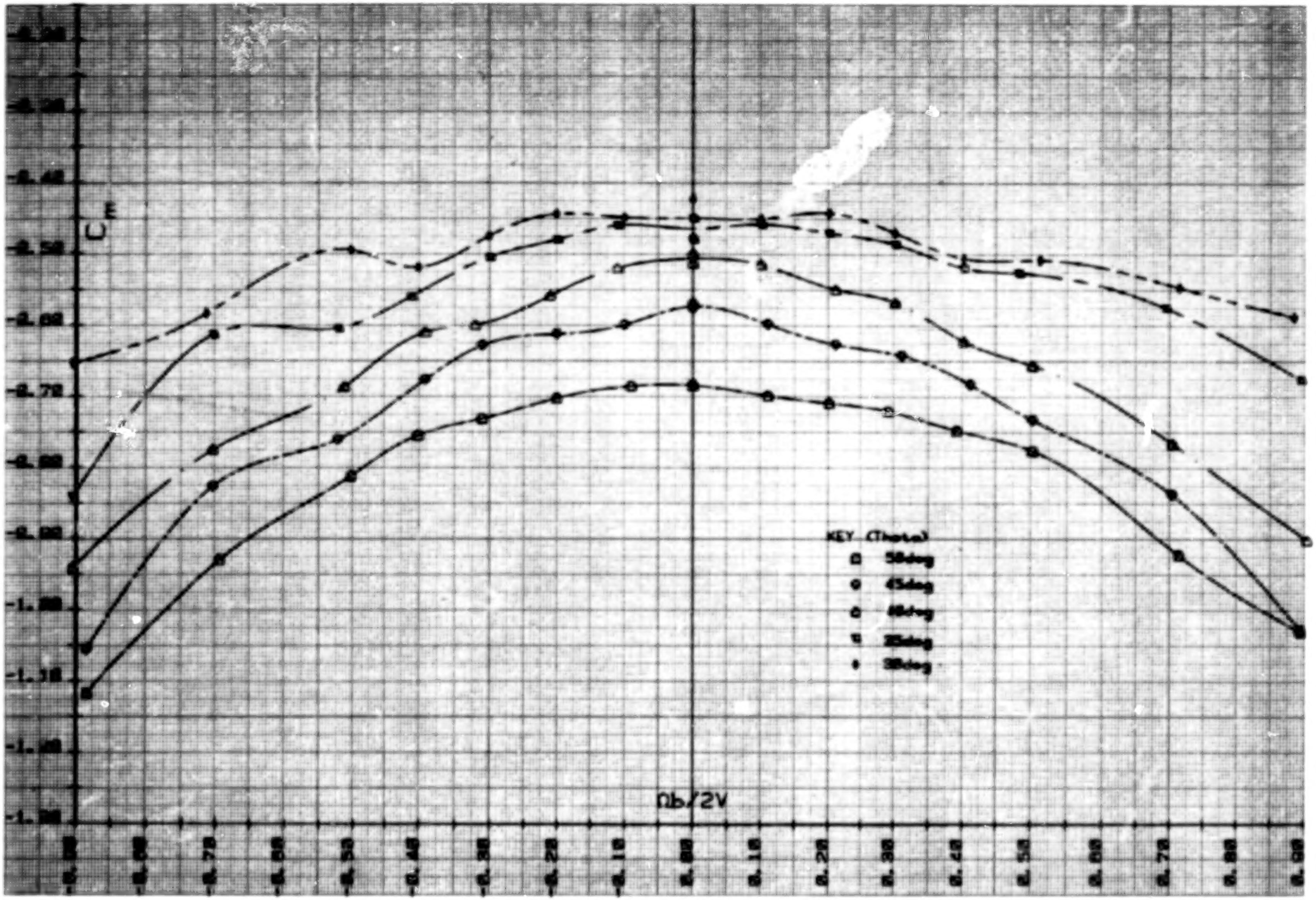
Figure 35. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+C.



a.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.5deg.

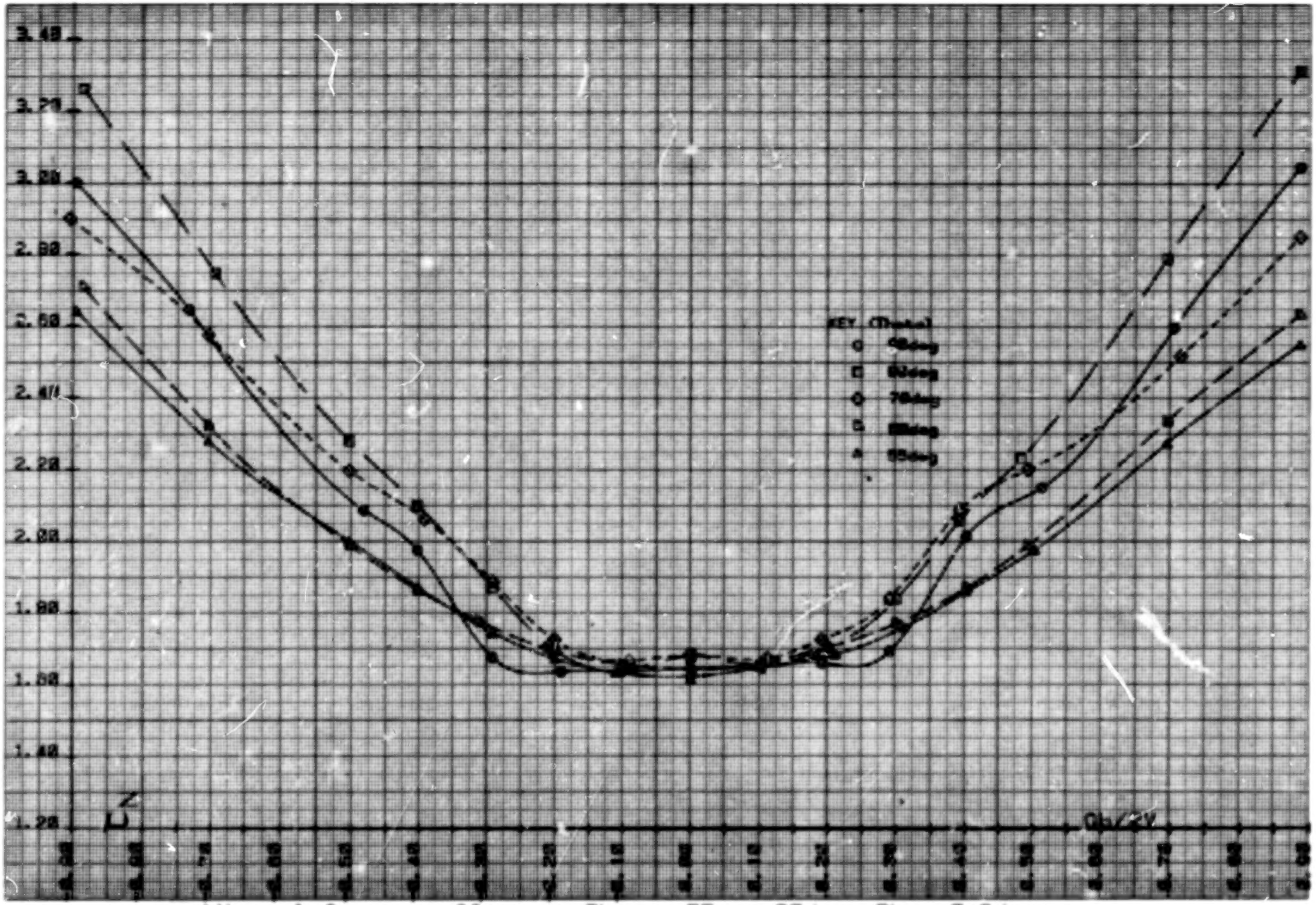
Figure 35. - Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+C.

262



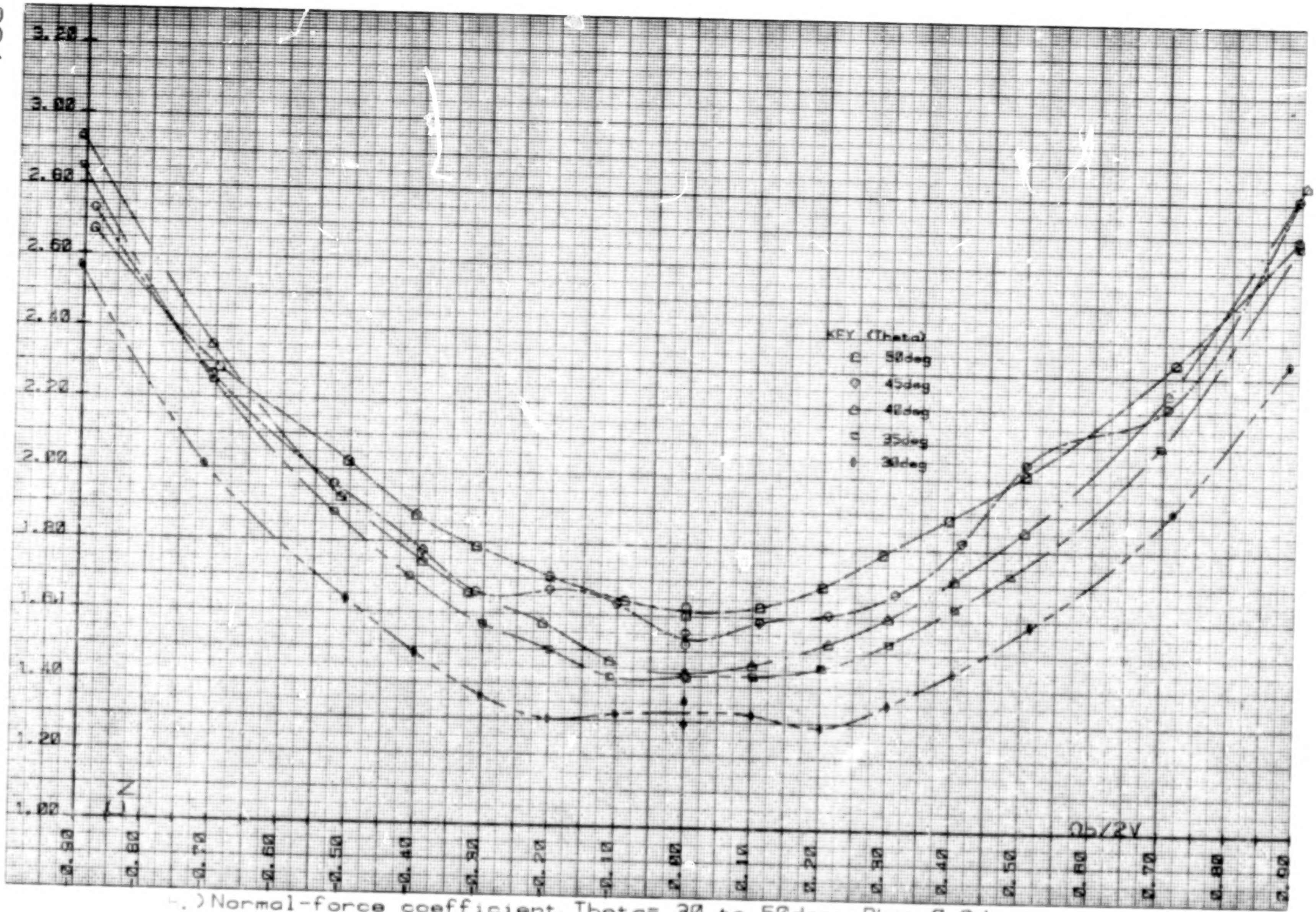
(f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 35.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+C.



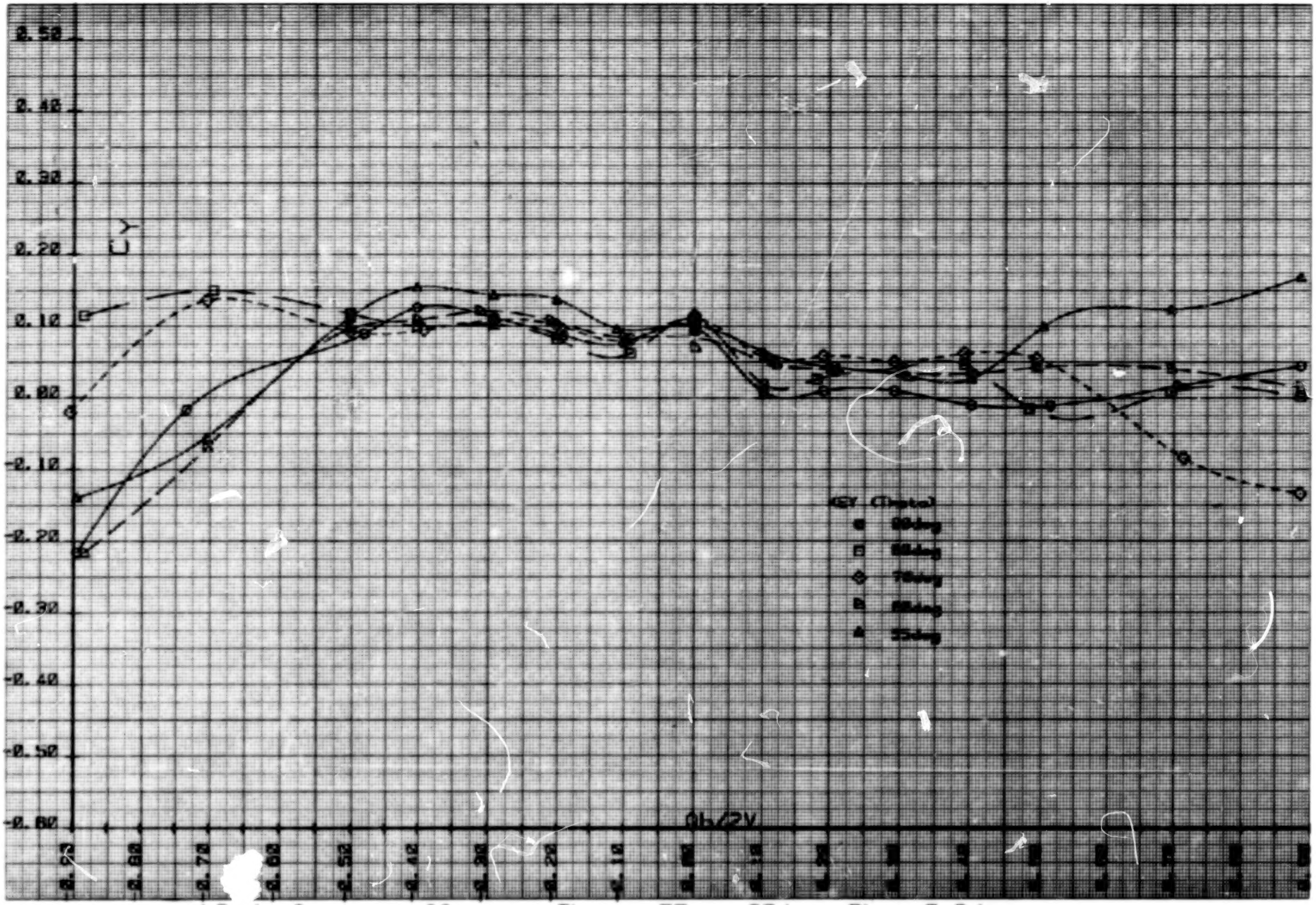
g.) Normal-force coefficient, Theta= 55 to 90deg: Phi=-0.2deg.

Figure 35.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+C.



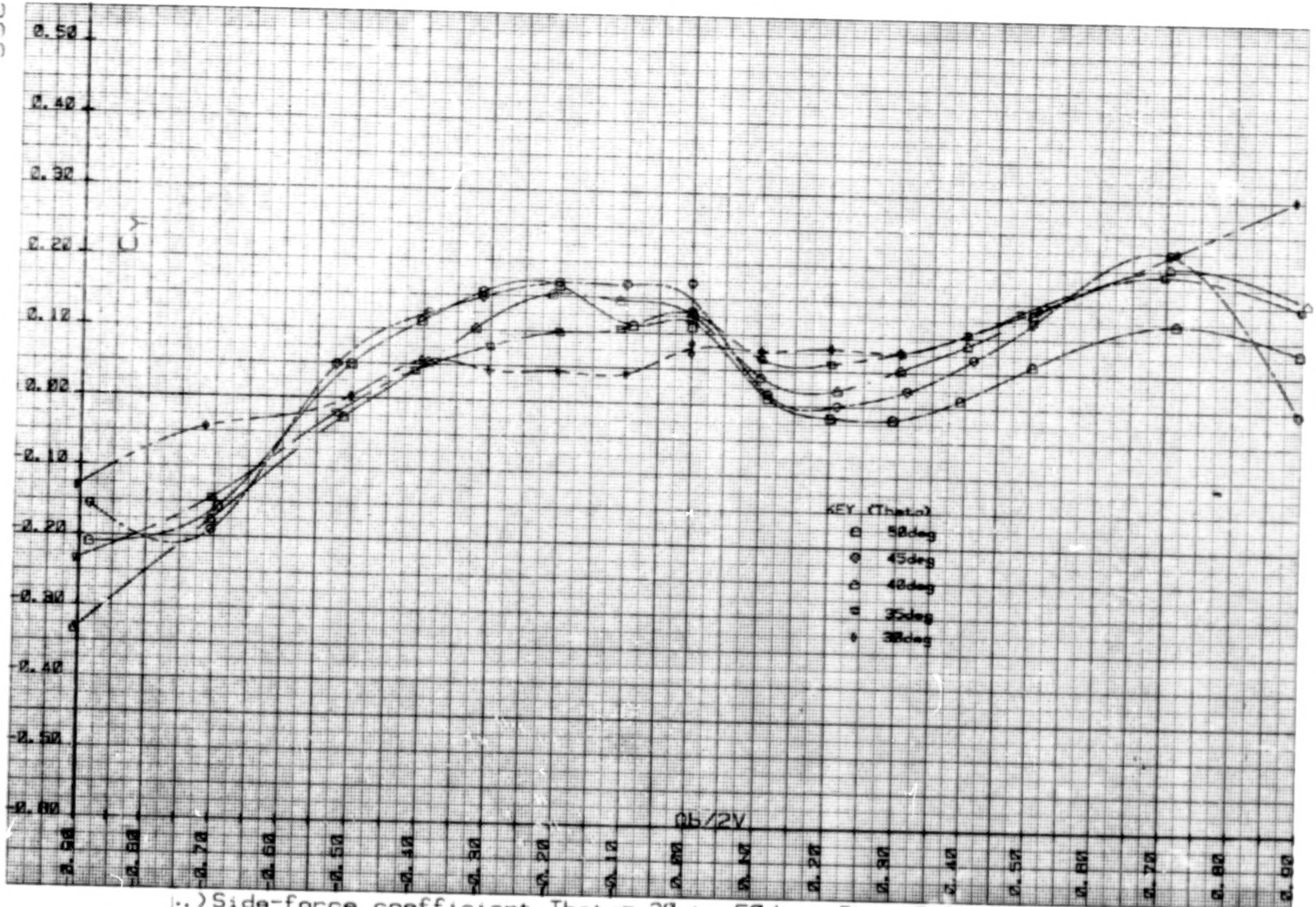
(...) Normal-force coefficient, Theta= 30 to 50deg; Phi≈-0.2deg.

Figure 35.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+C.



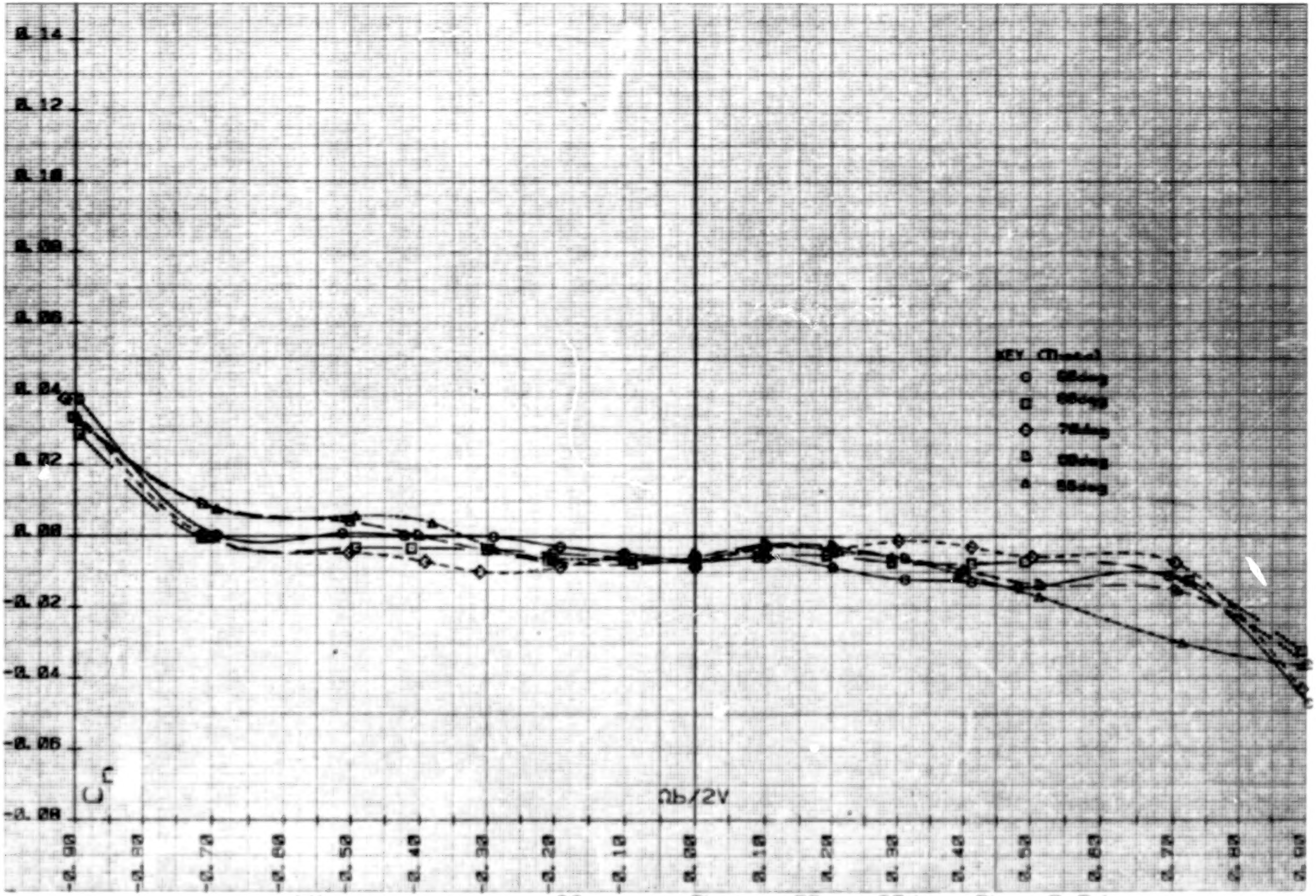
(.)Side-force coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 35.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+C.



j..) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 35. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+C.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.5deg.

Figure 36.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sh.

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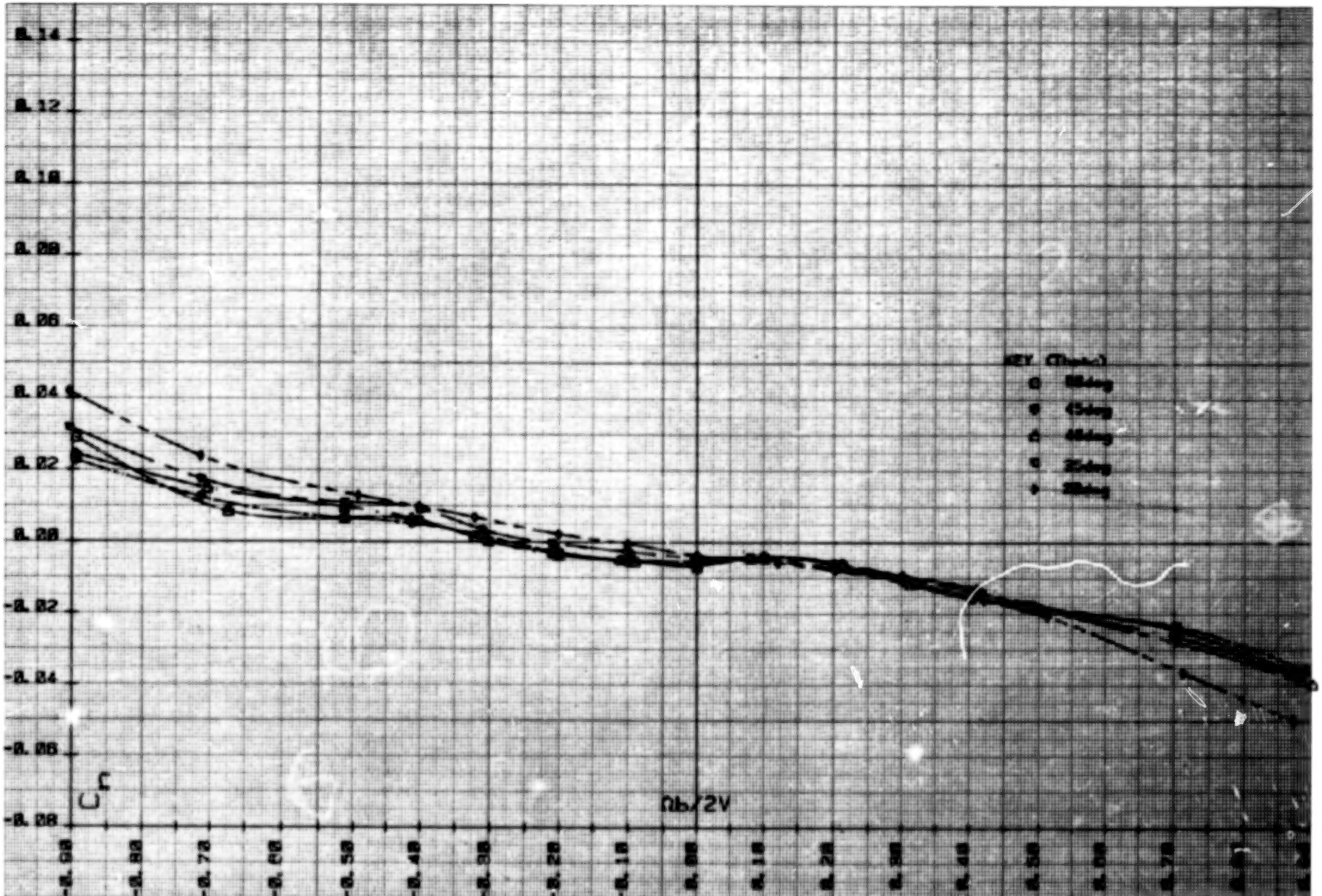
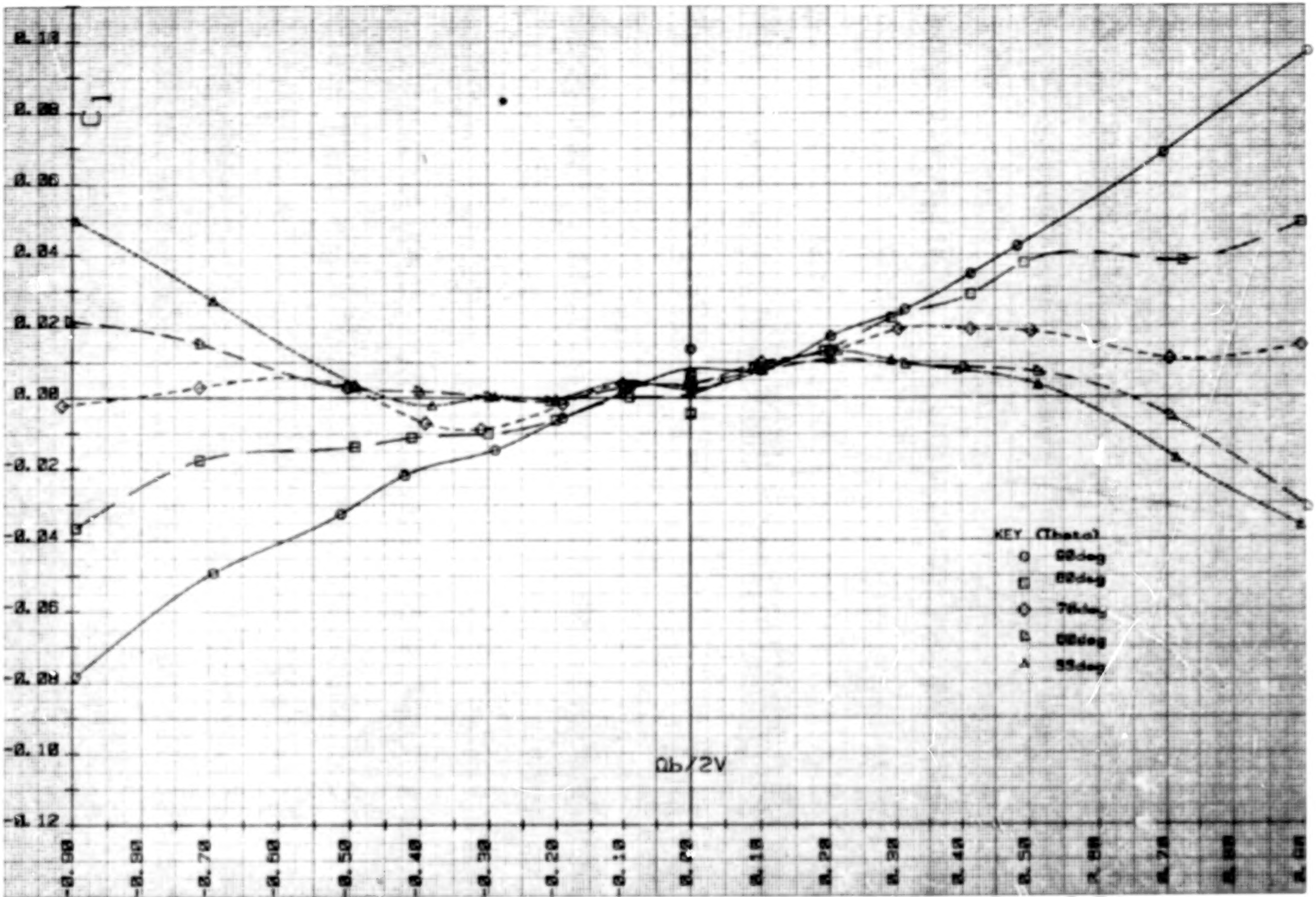


b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 36.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sh.



(.)Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.5deg.

Figure 36.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sh.

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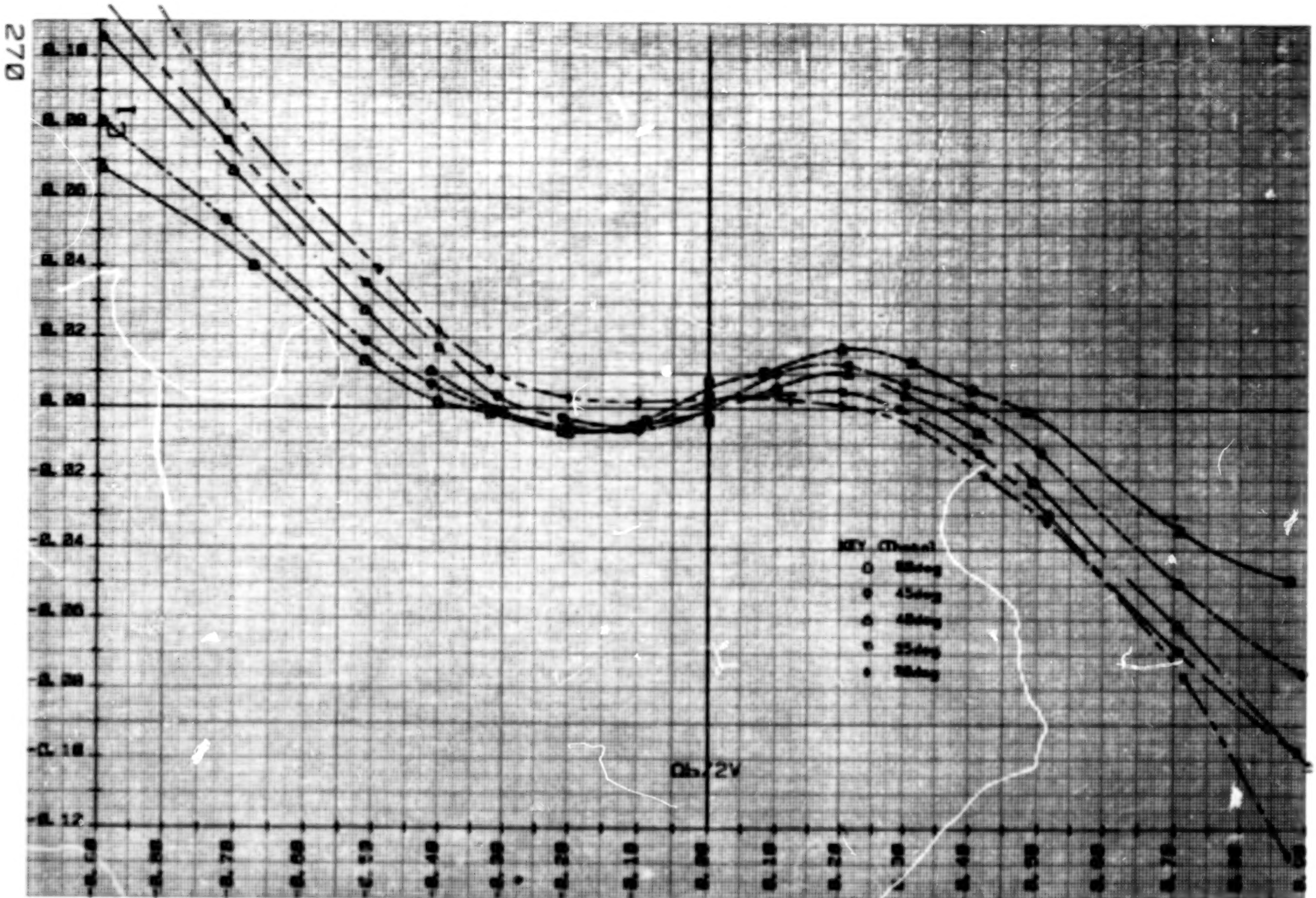
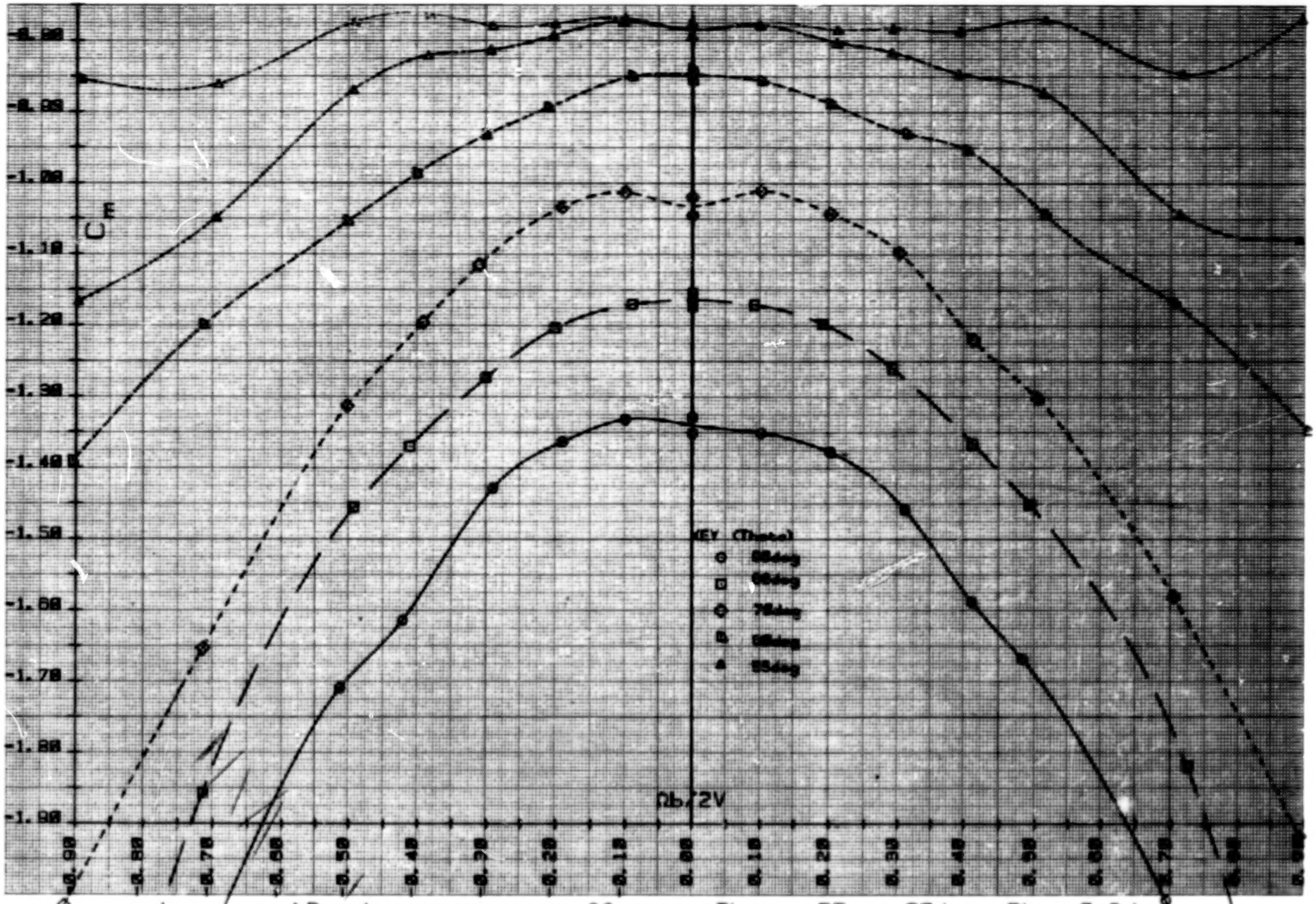


d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 36.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sh.



a.)Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 36.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sh.

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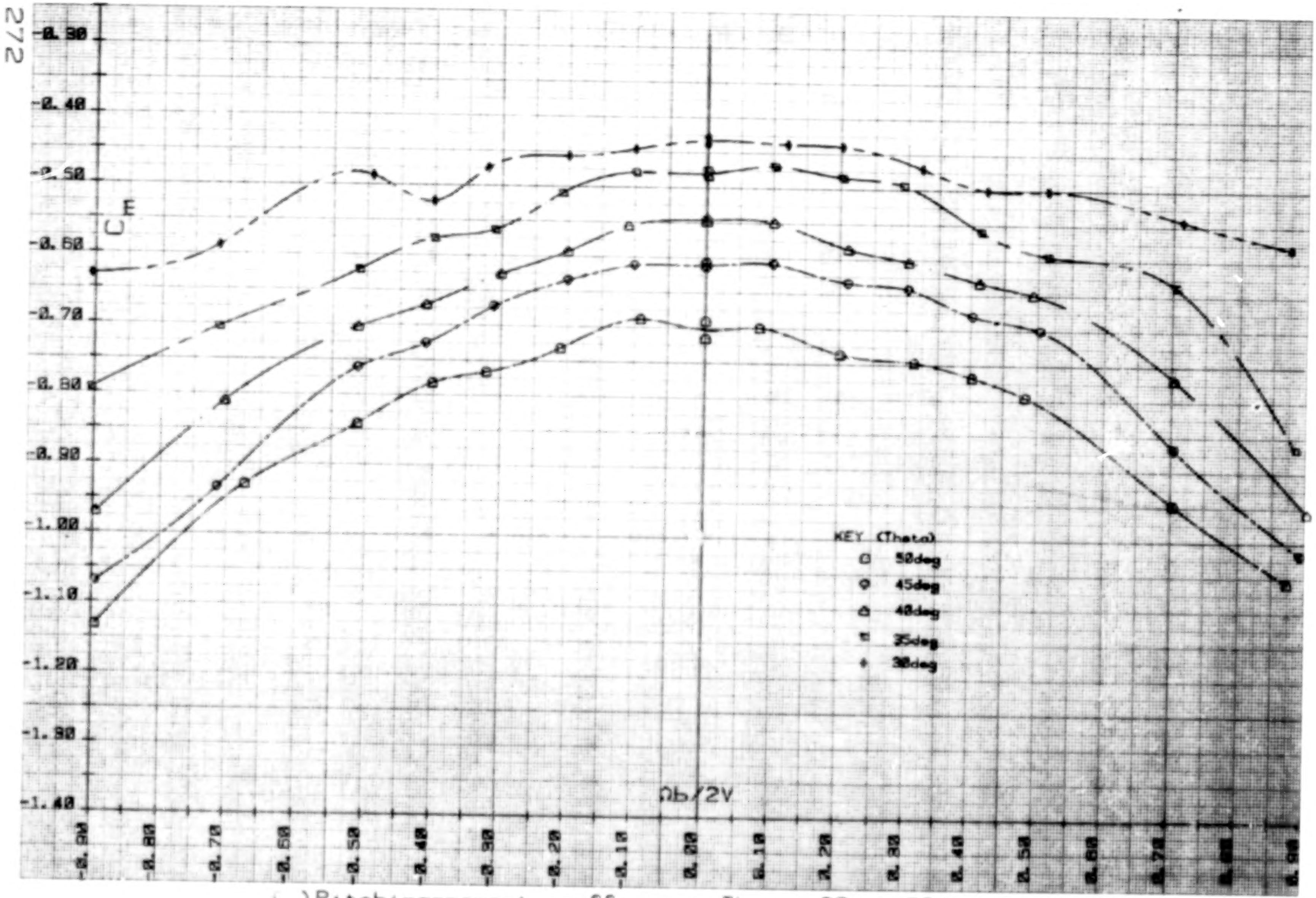
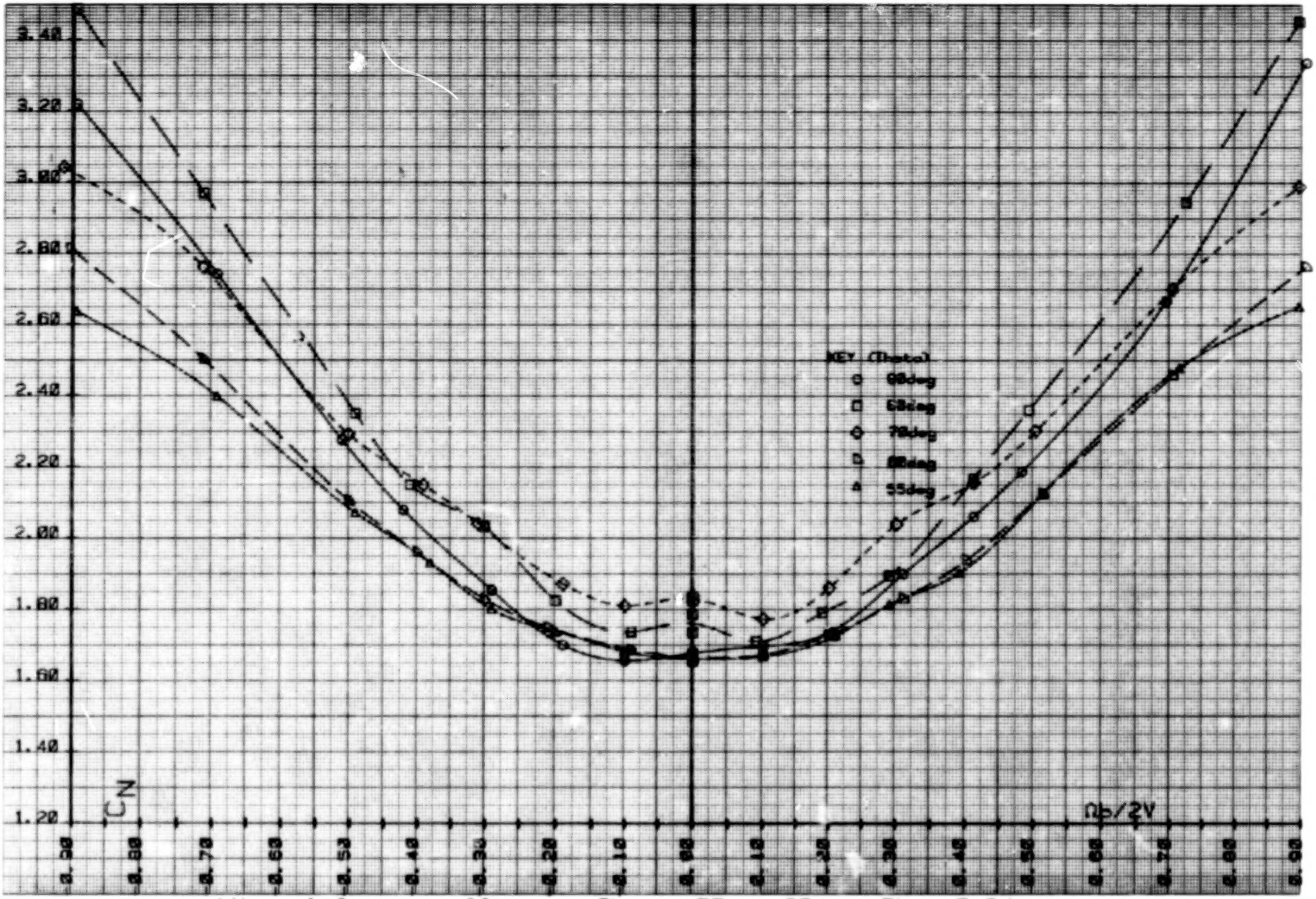


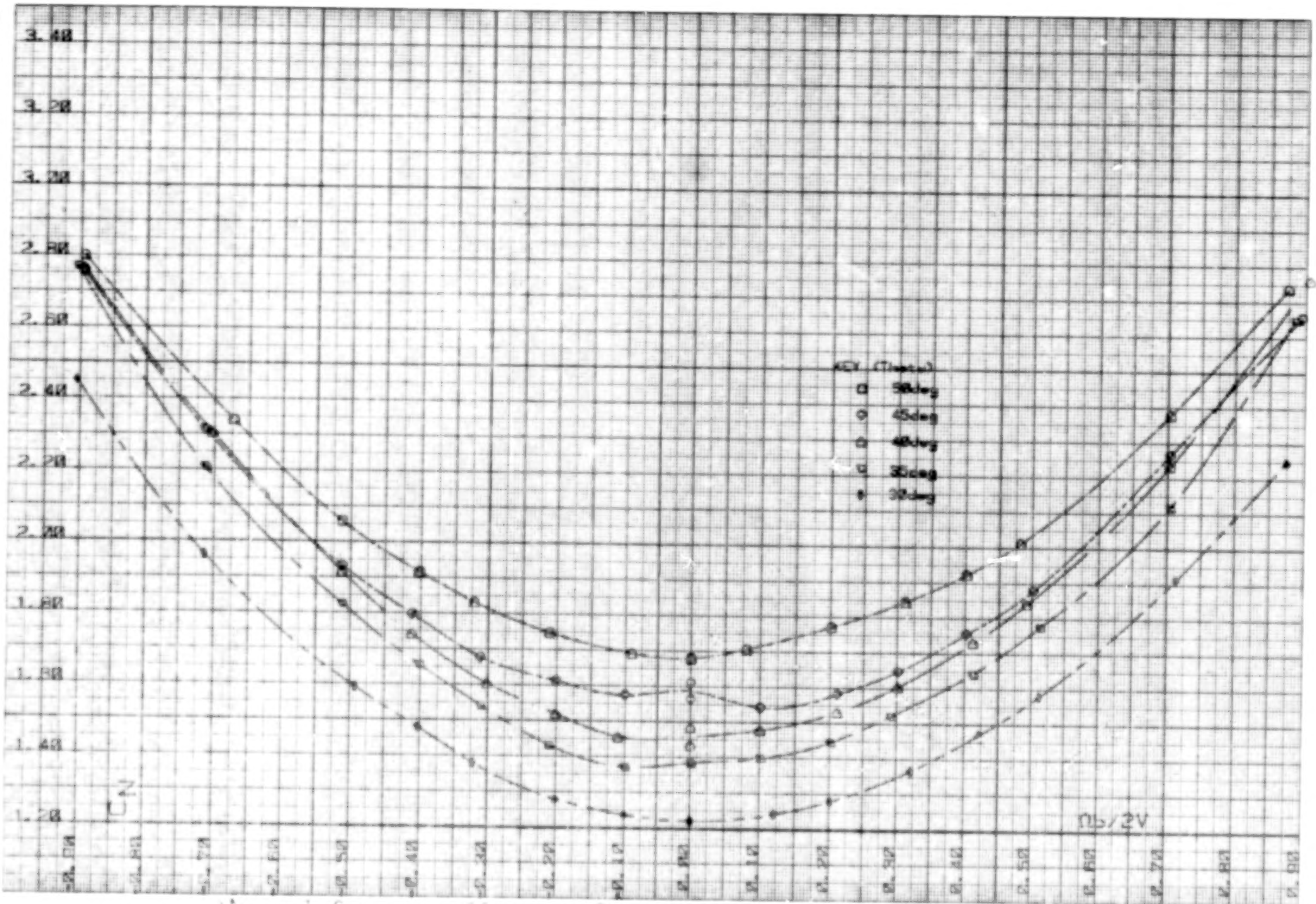
(.) Pitching-moment coefficient. Theta= 30 to 50deg; Phi=-0.3deg.

Figure 36.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sh.



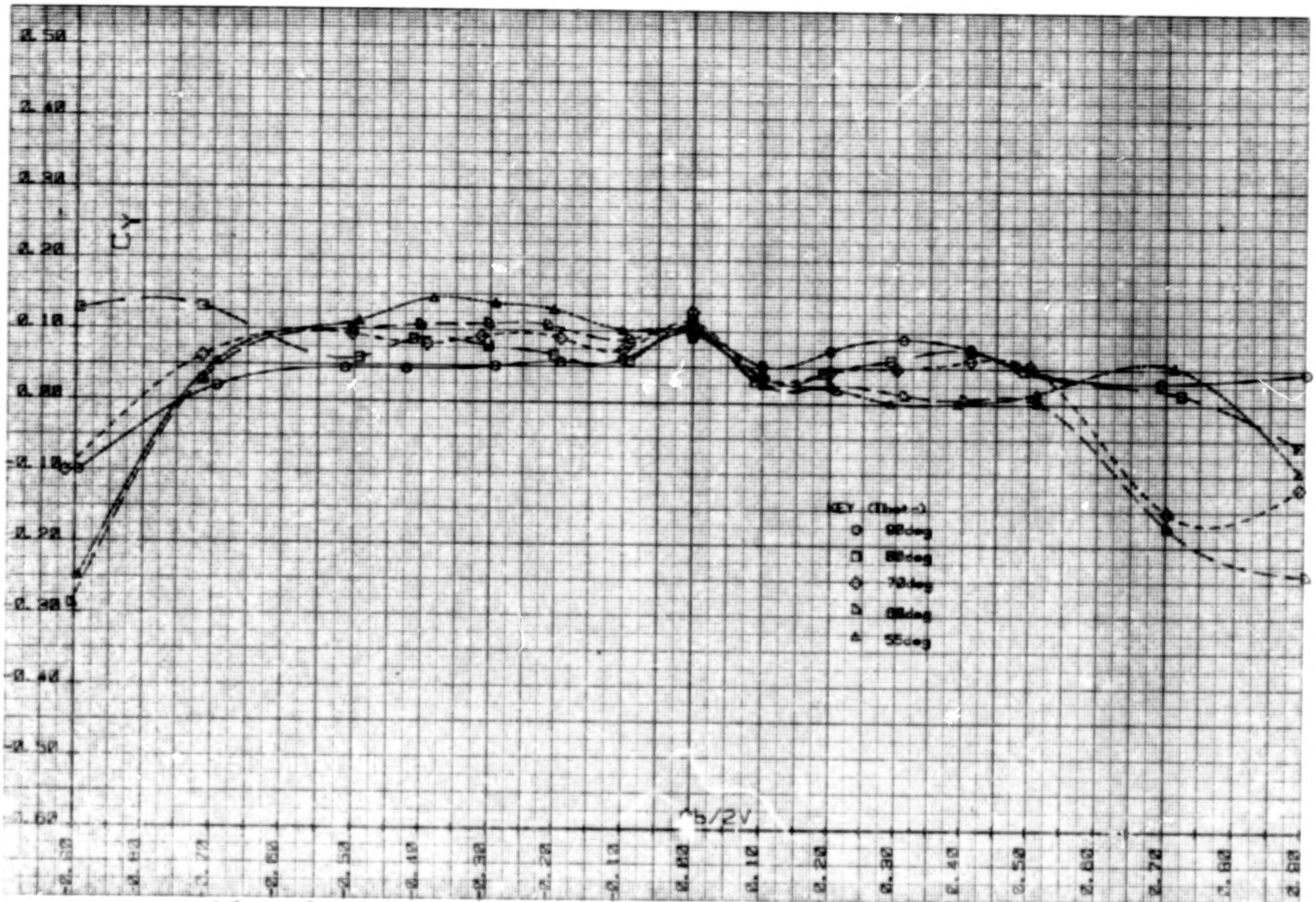
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 36. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sh.



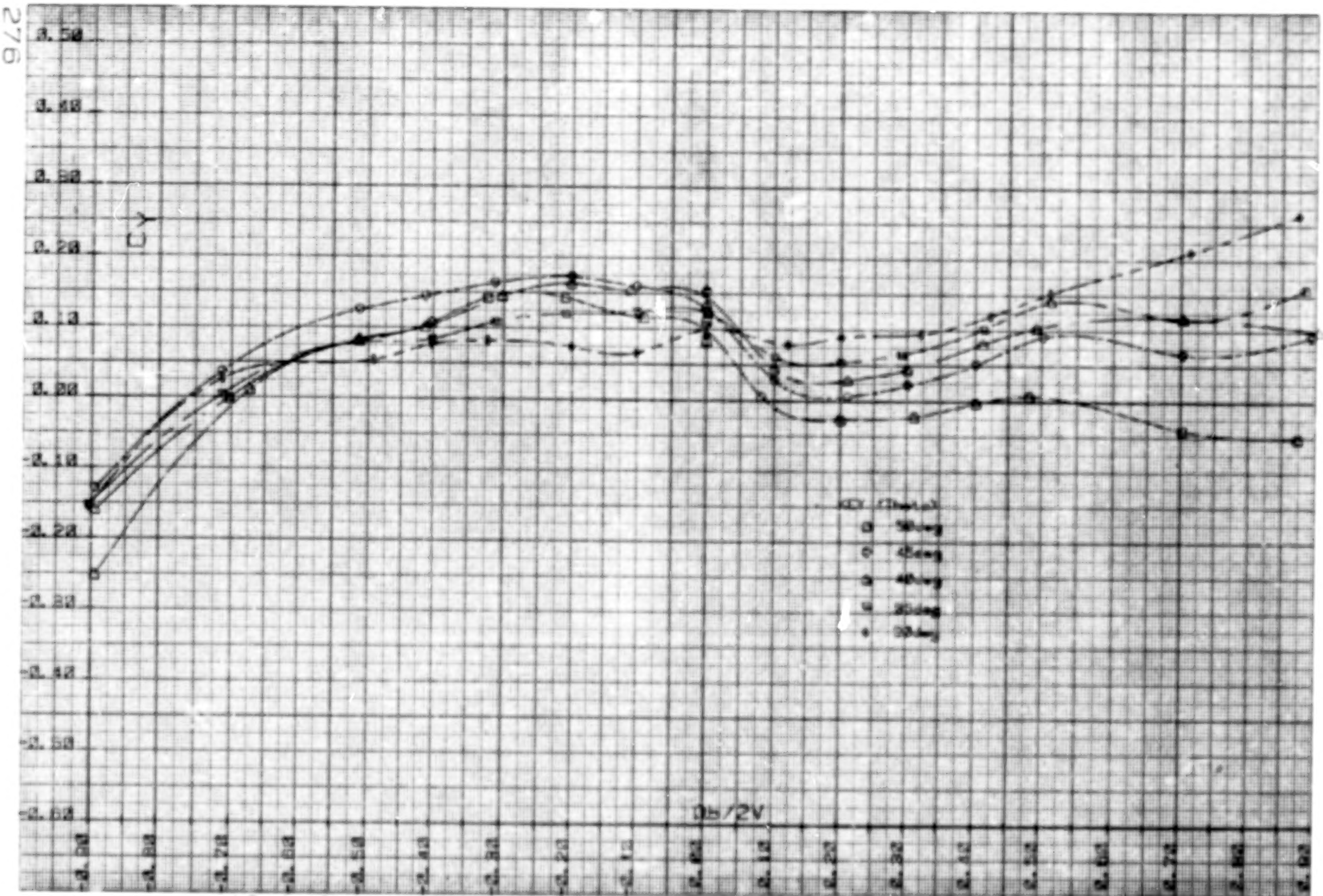
(c) Normal-force coefficient. Theta= 30 to 50deg; Phi=-0.2deg.

Figure 36.- Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sh.



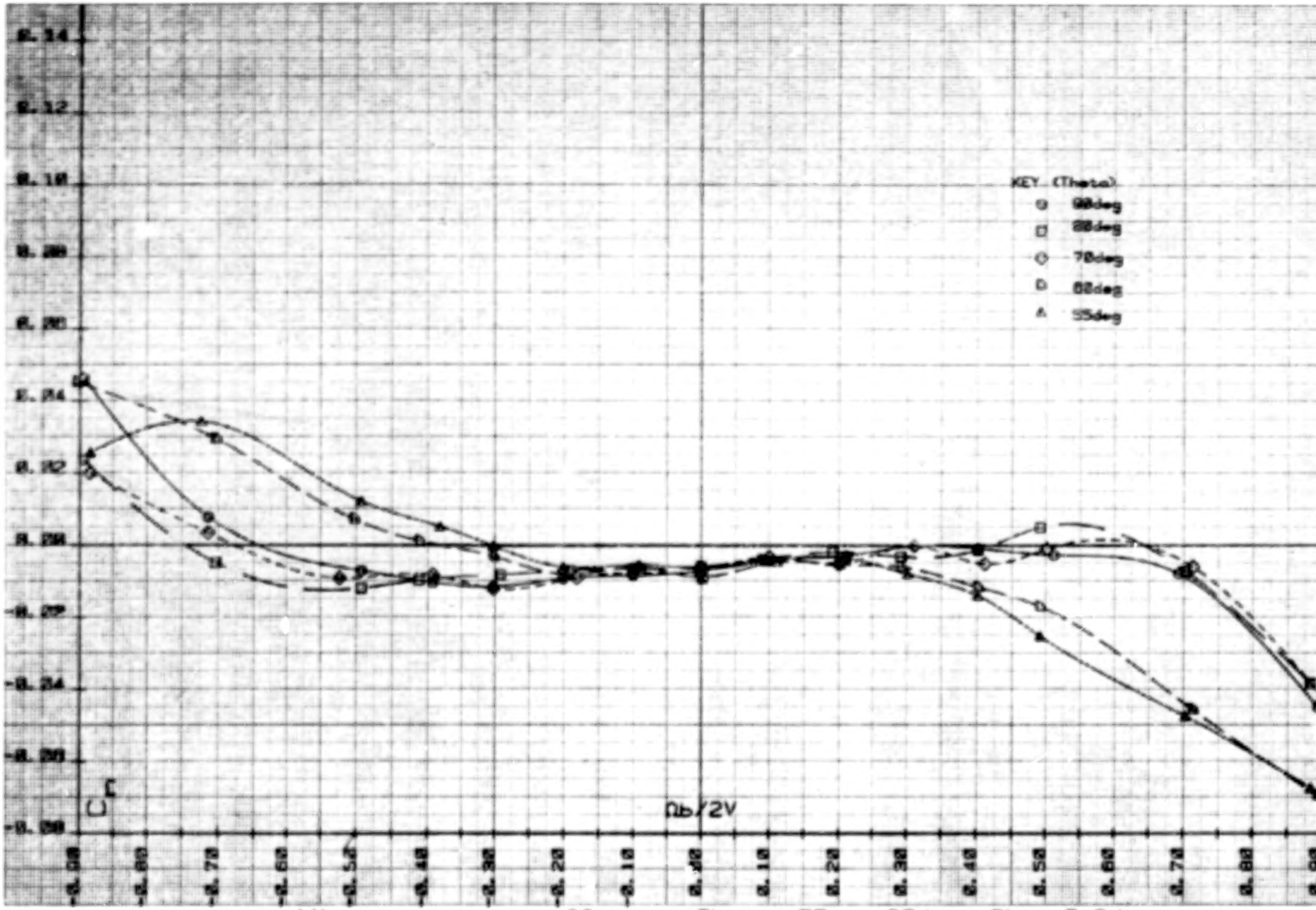
) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.5deg.

Figure 36.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sh.



(j) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 36. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sh.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.6deg.

Figure 37.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sv.

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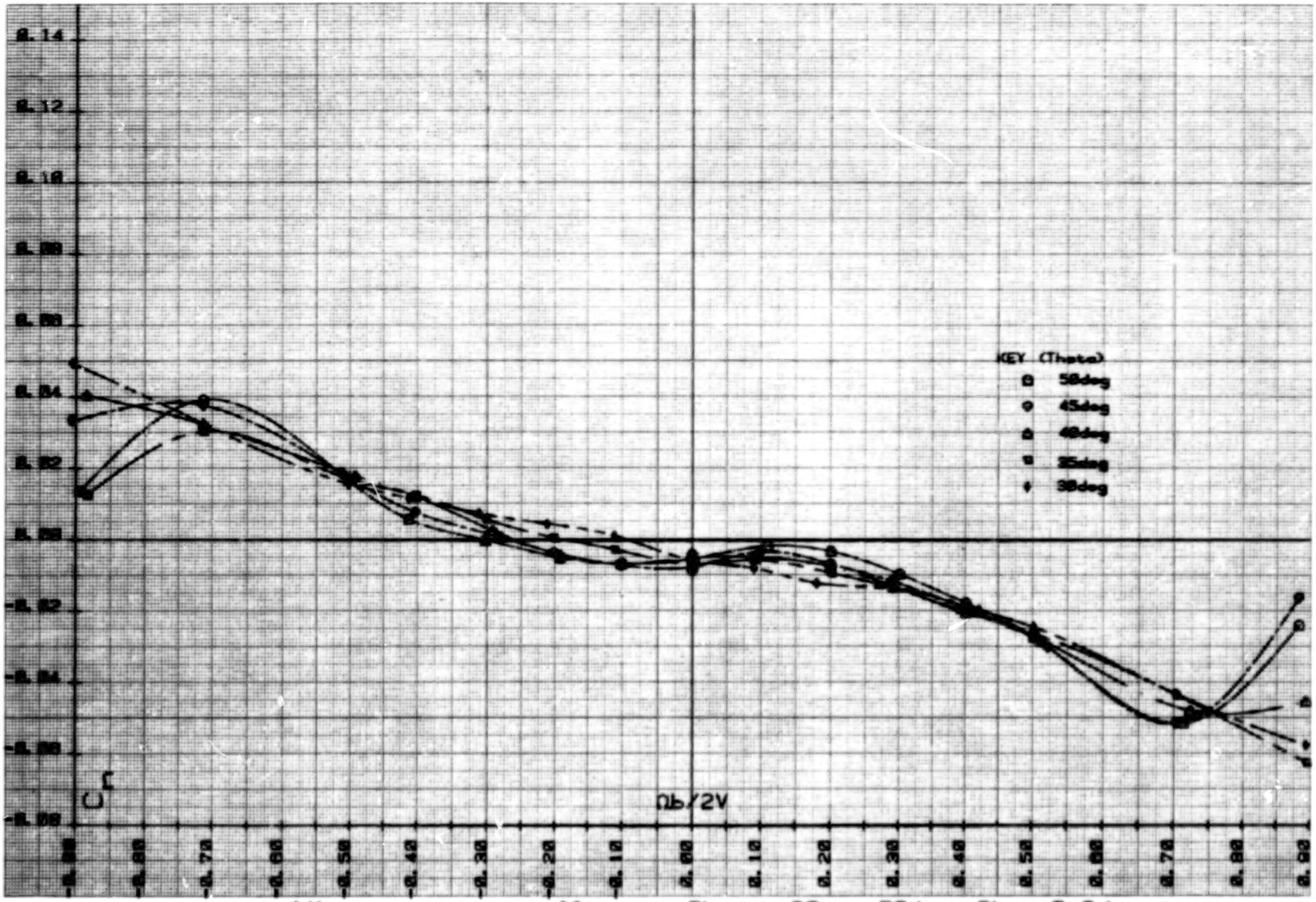
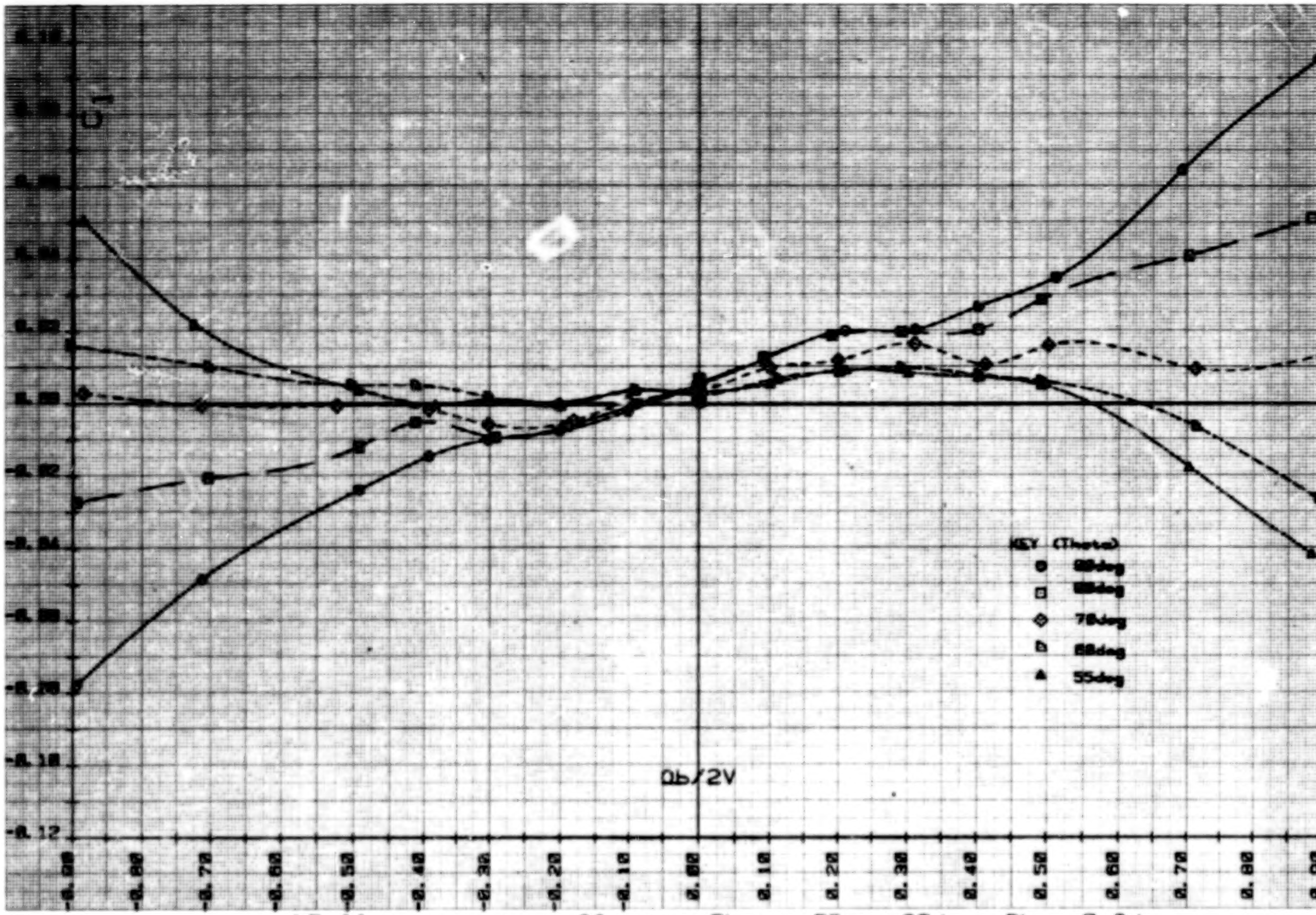


b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 37.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sv.



(c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 37.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sv.

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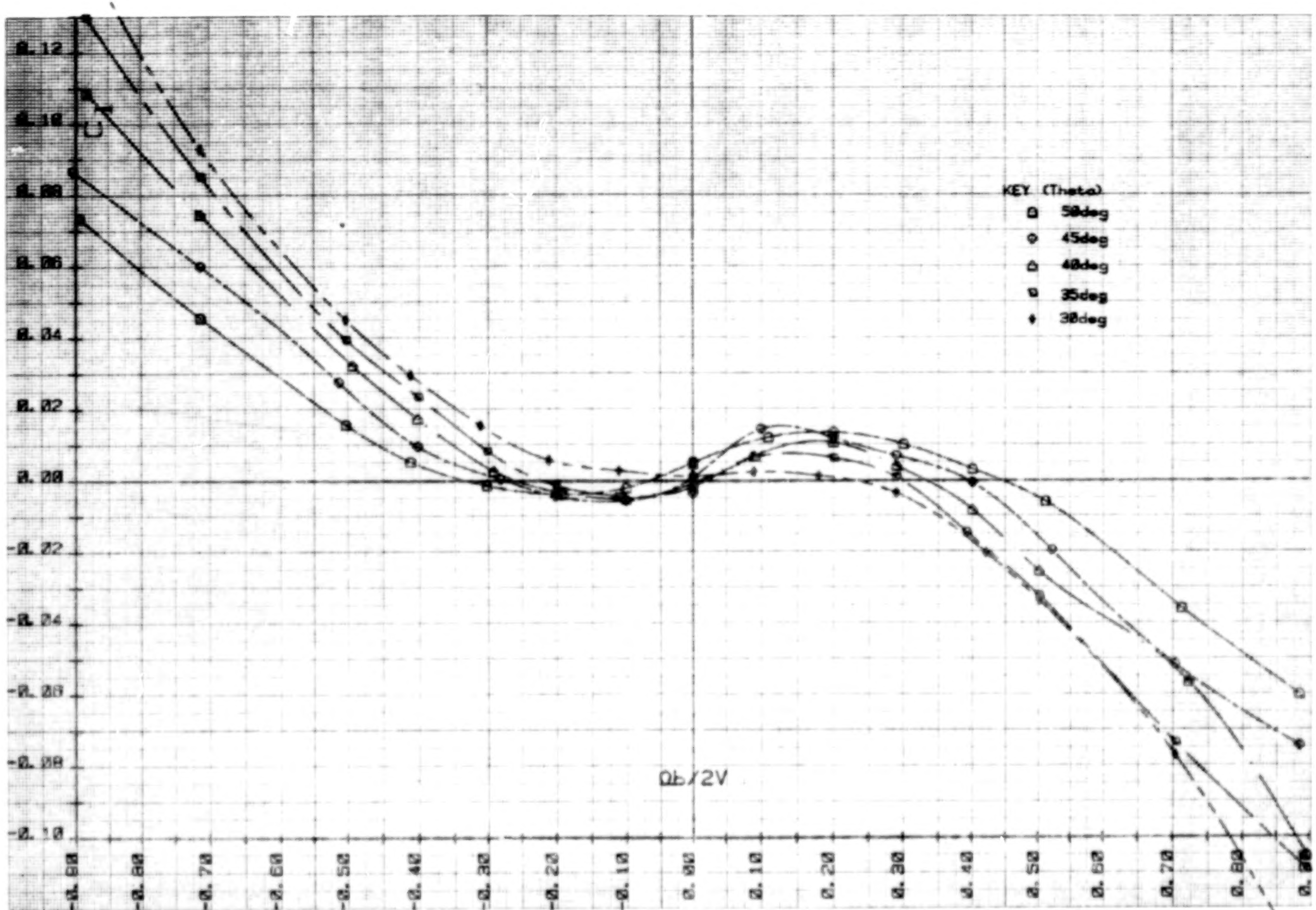
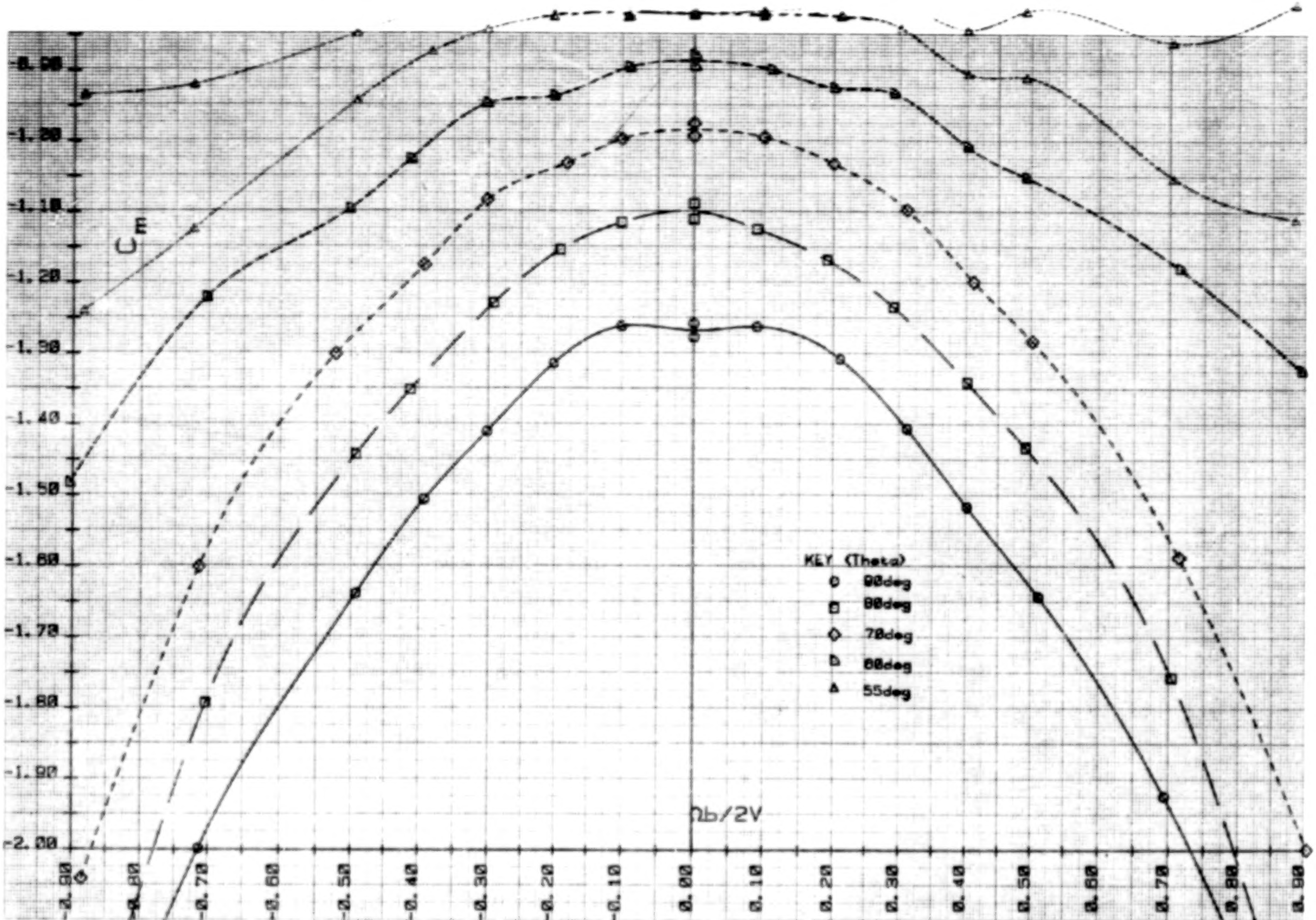


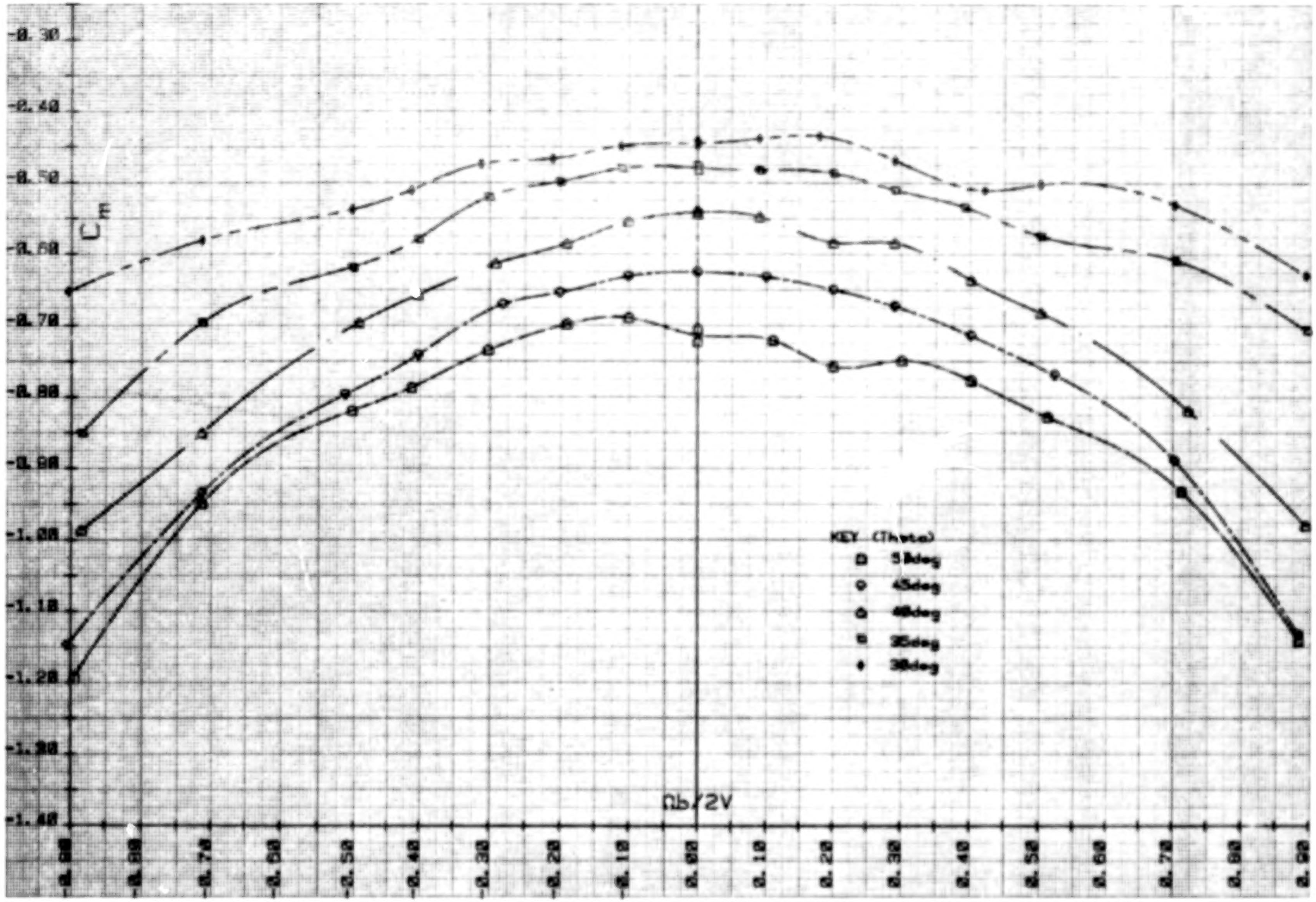
( )Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

Figure 37.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sv.



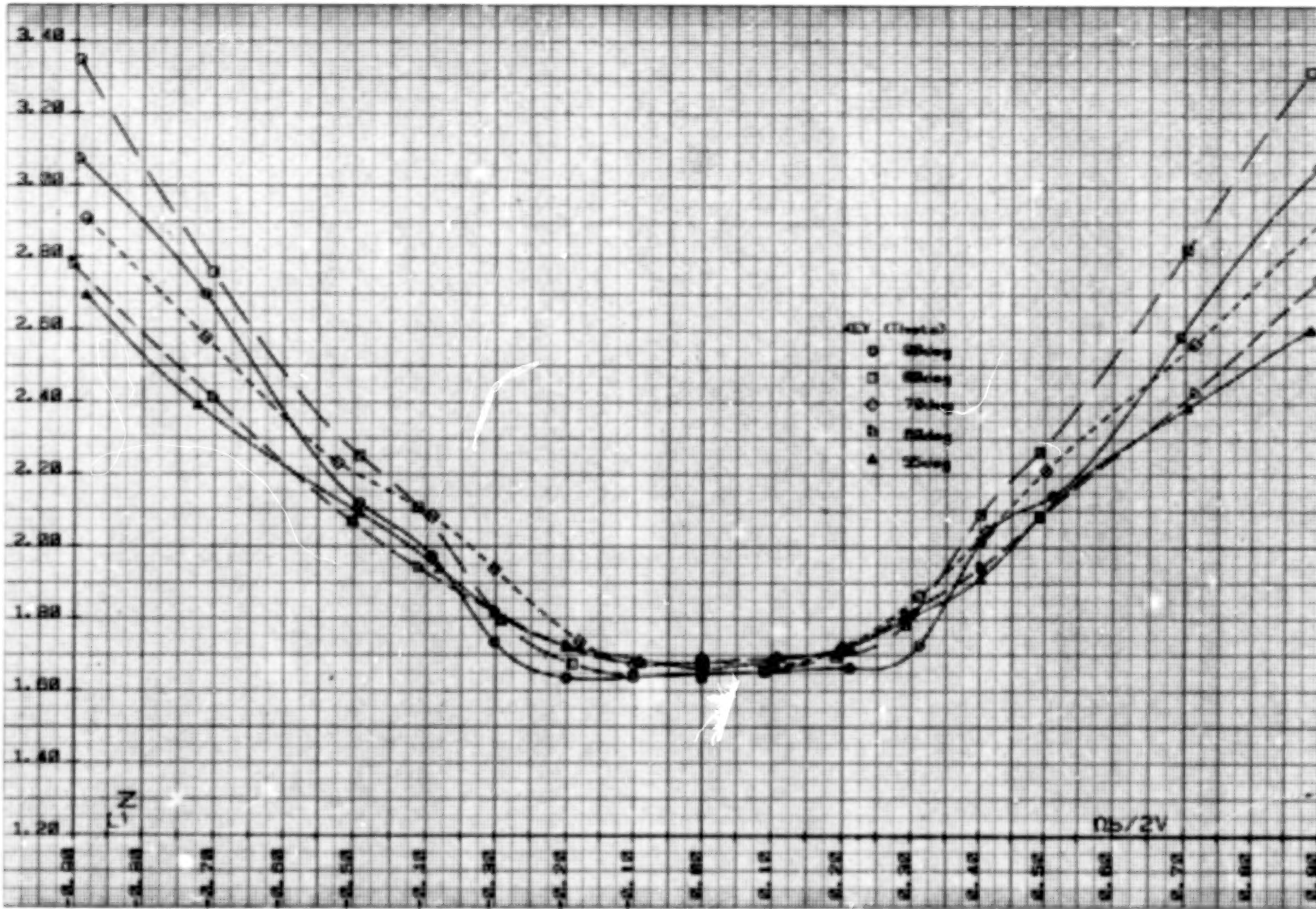
) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.6deg.

Figure 37.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sv.



(f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 37.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sv.



g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.6deg.

Figure 37. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sv.

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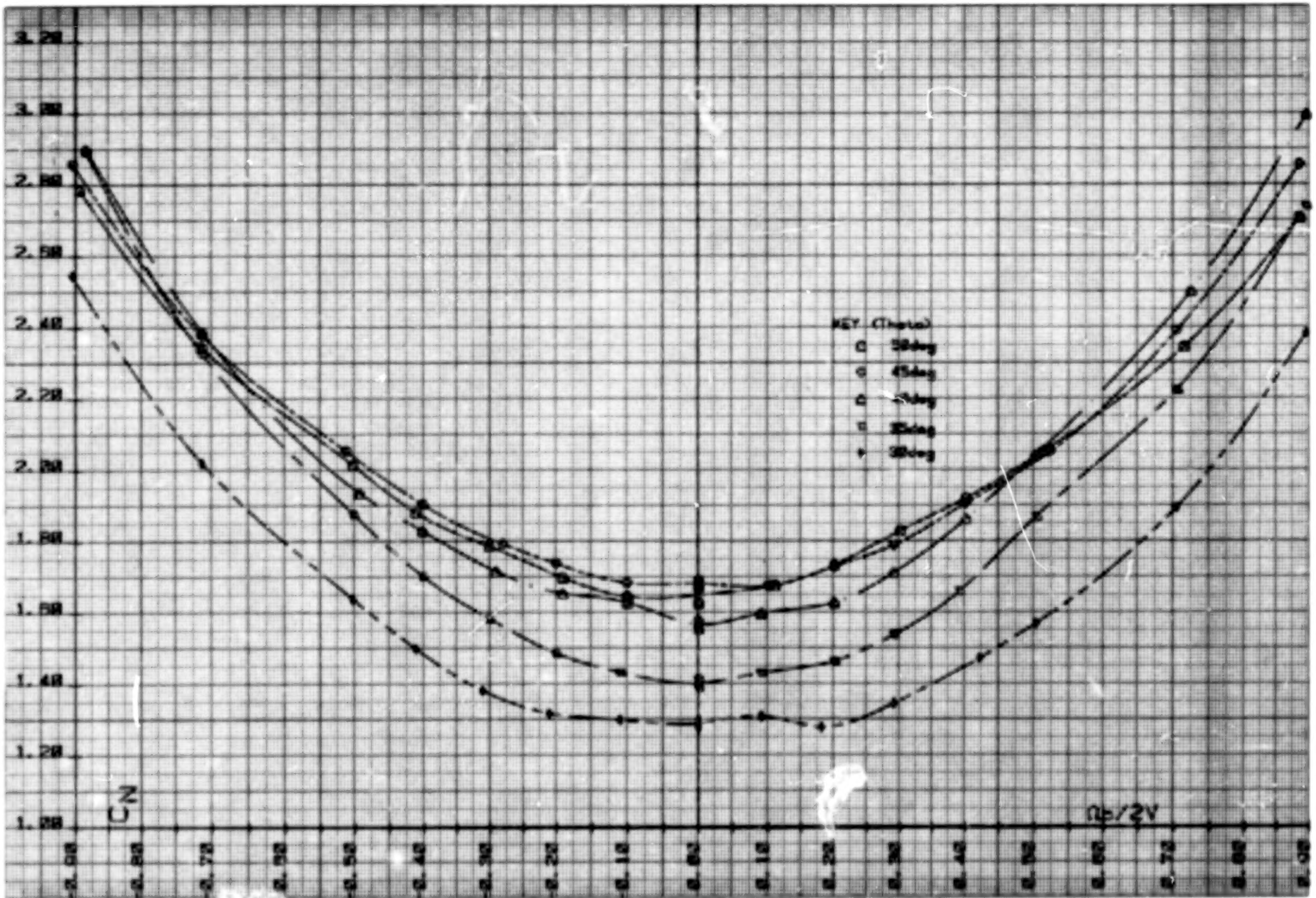
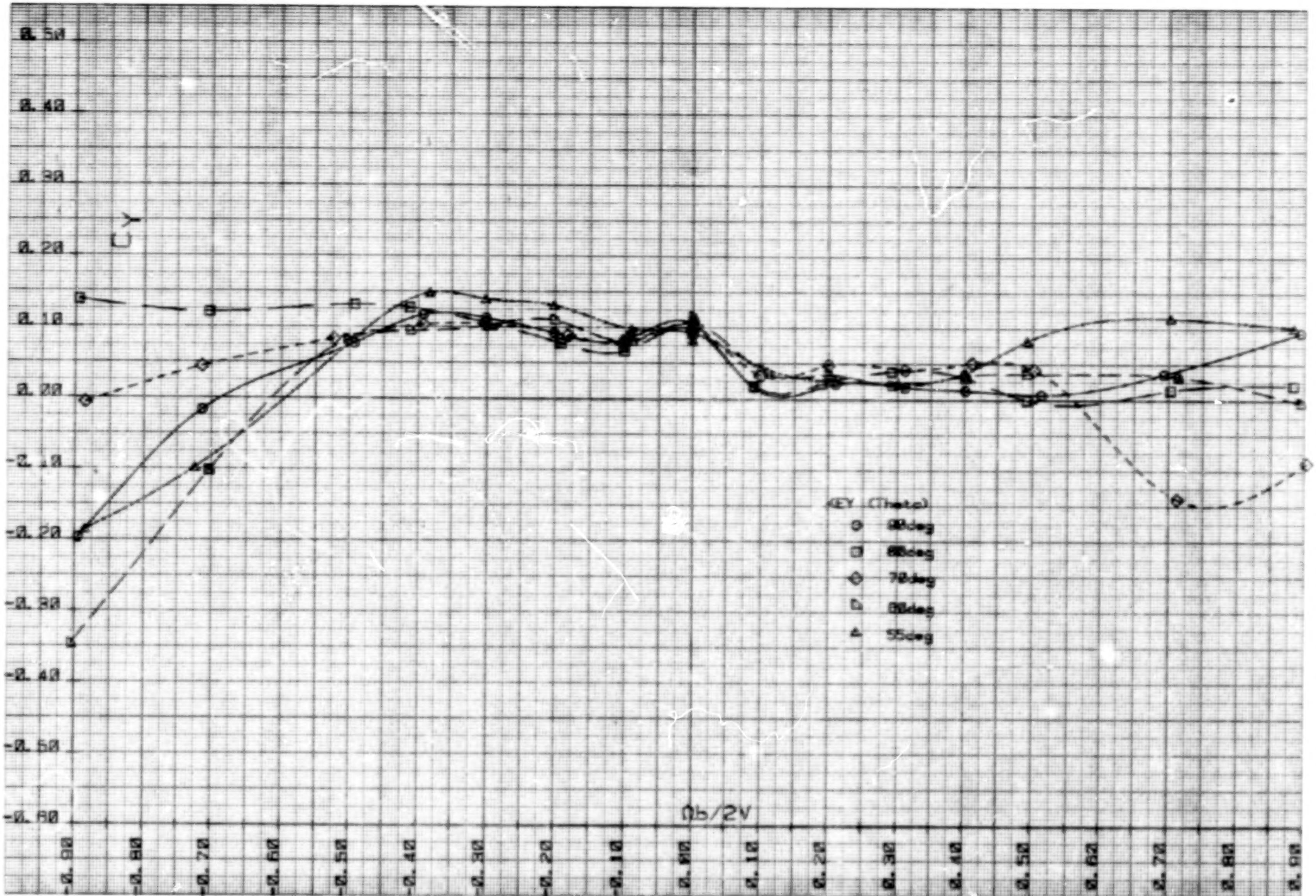


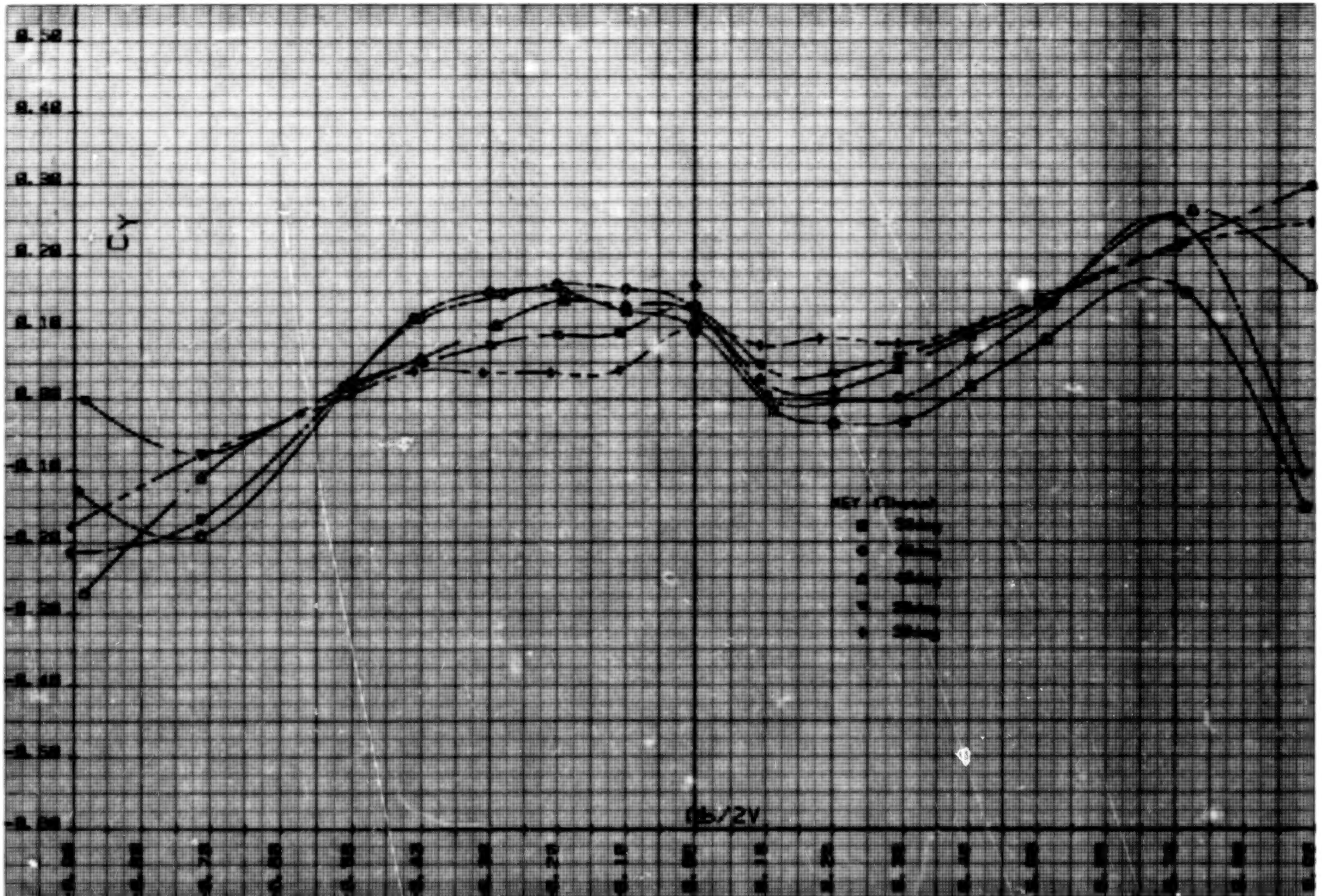
(b) [illegible]nal-force coefficient. Theta= 30 to 50deg; Phi=-0.3deg.

Figure 37. -E[illegible]ect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sv.



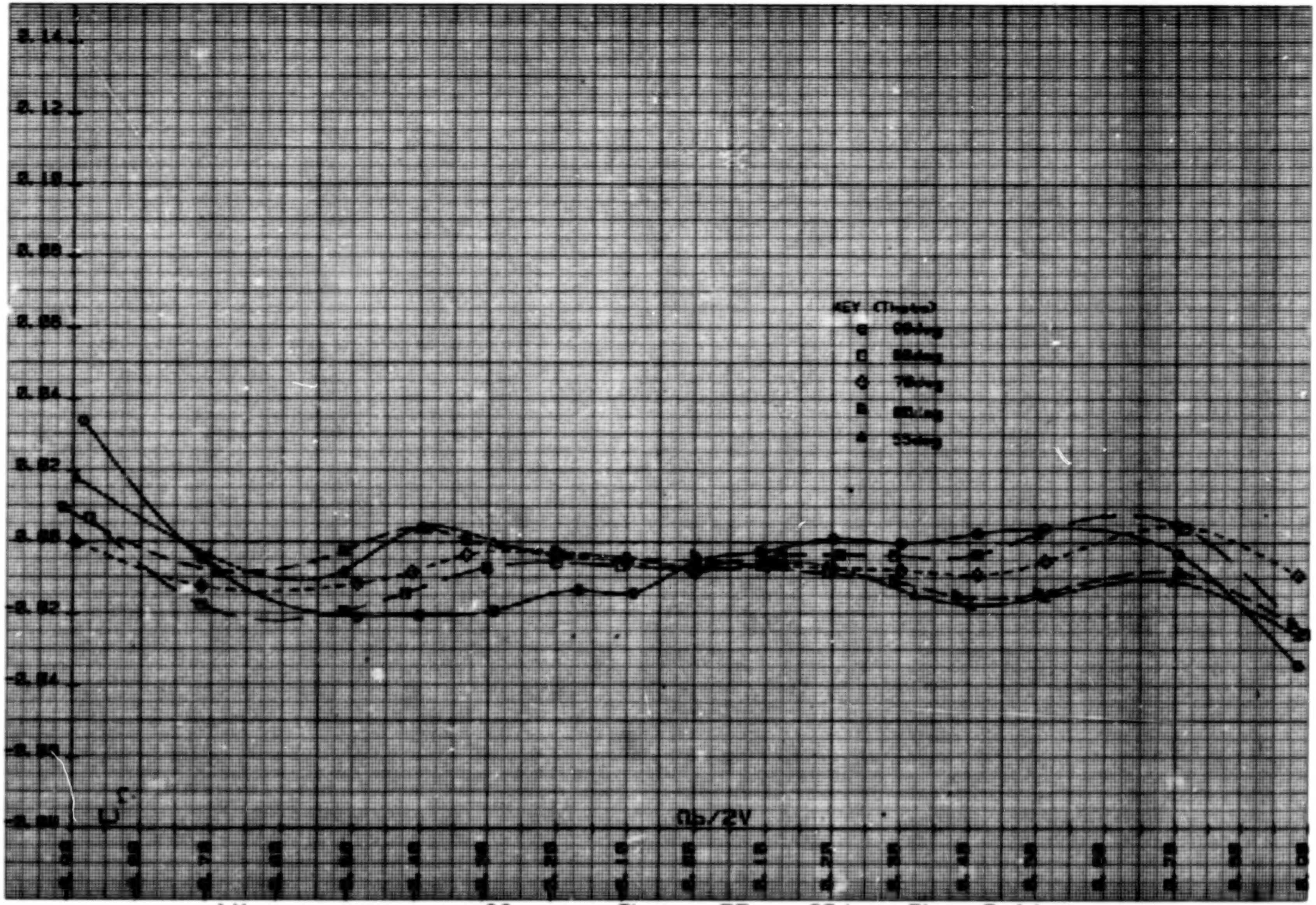
(a) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 37.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sv.



j.) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

Figure 37.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sv.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 38. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sc.

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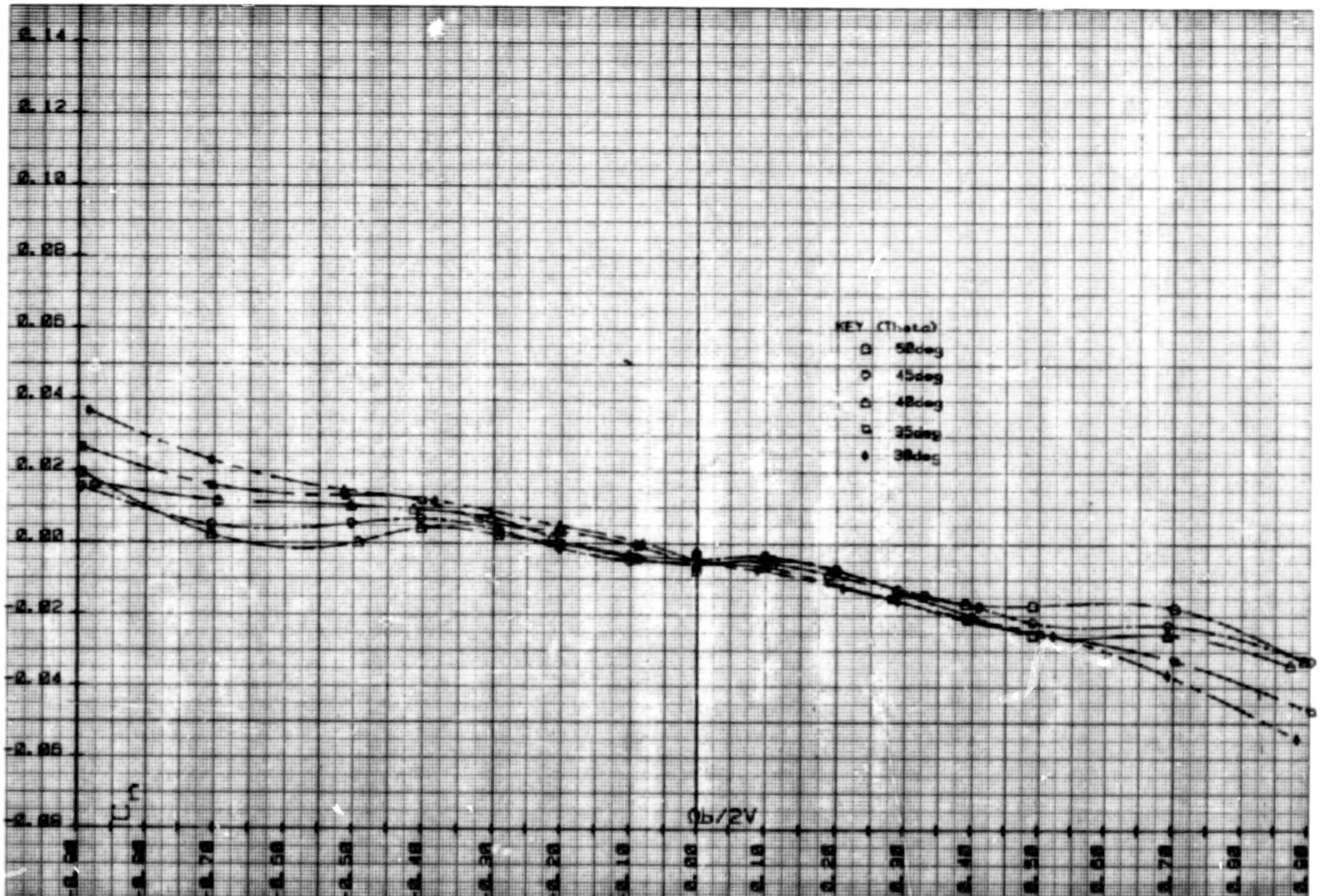
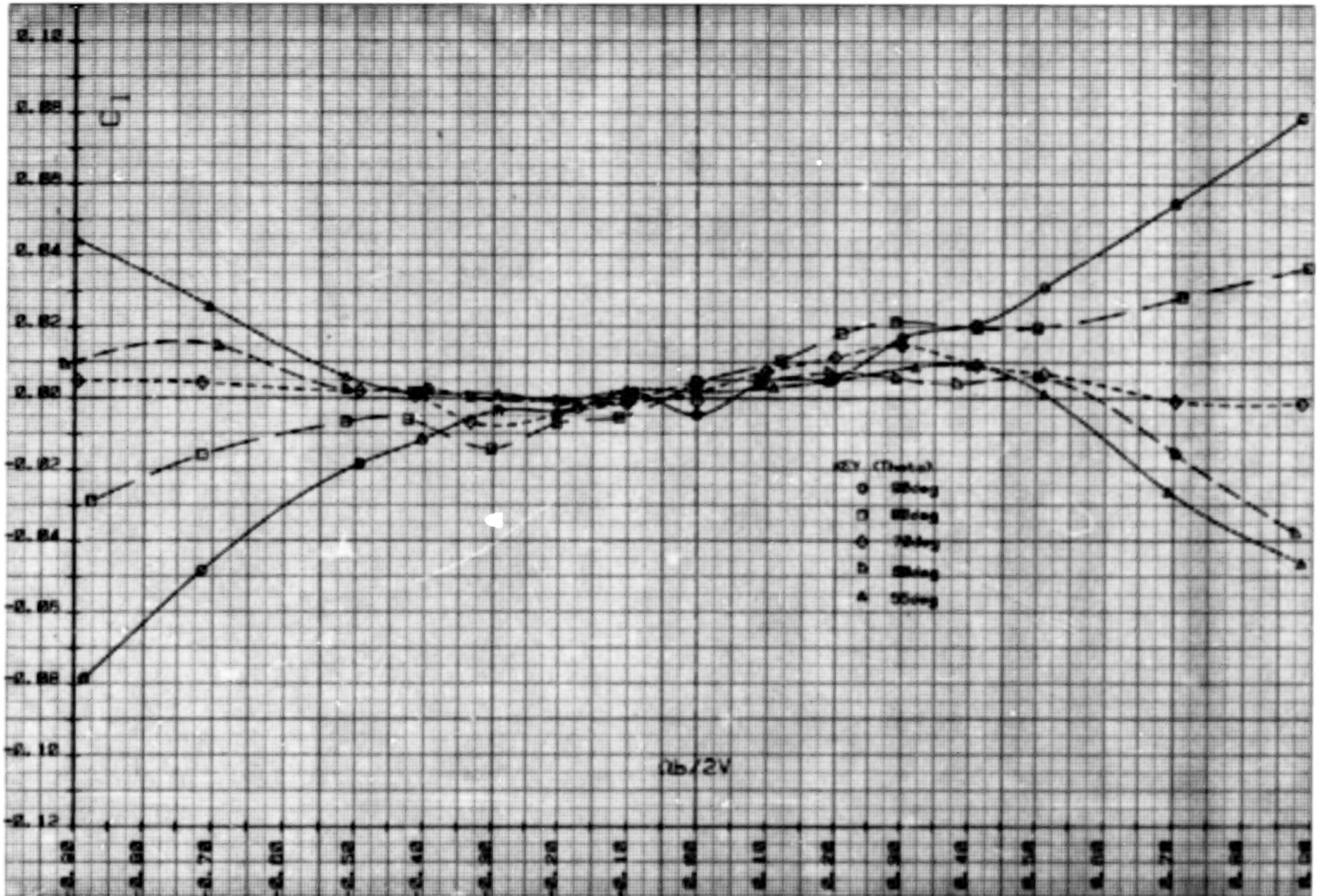


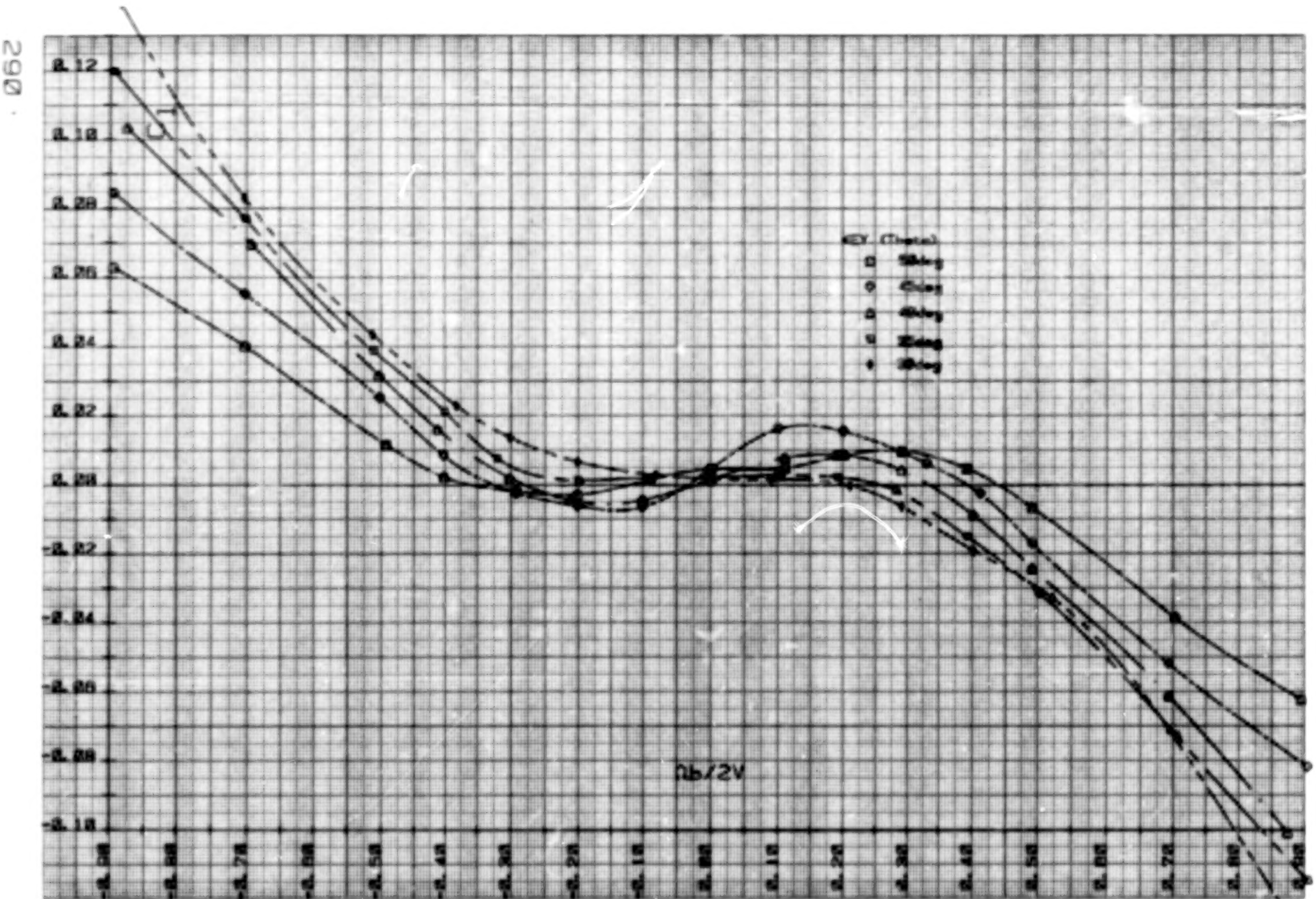
b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 38.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sc.



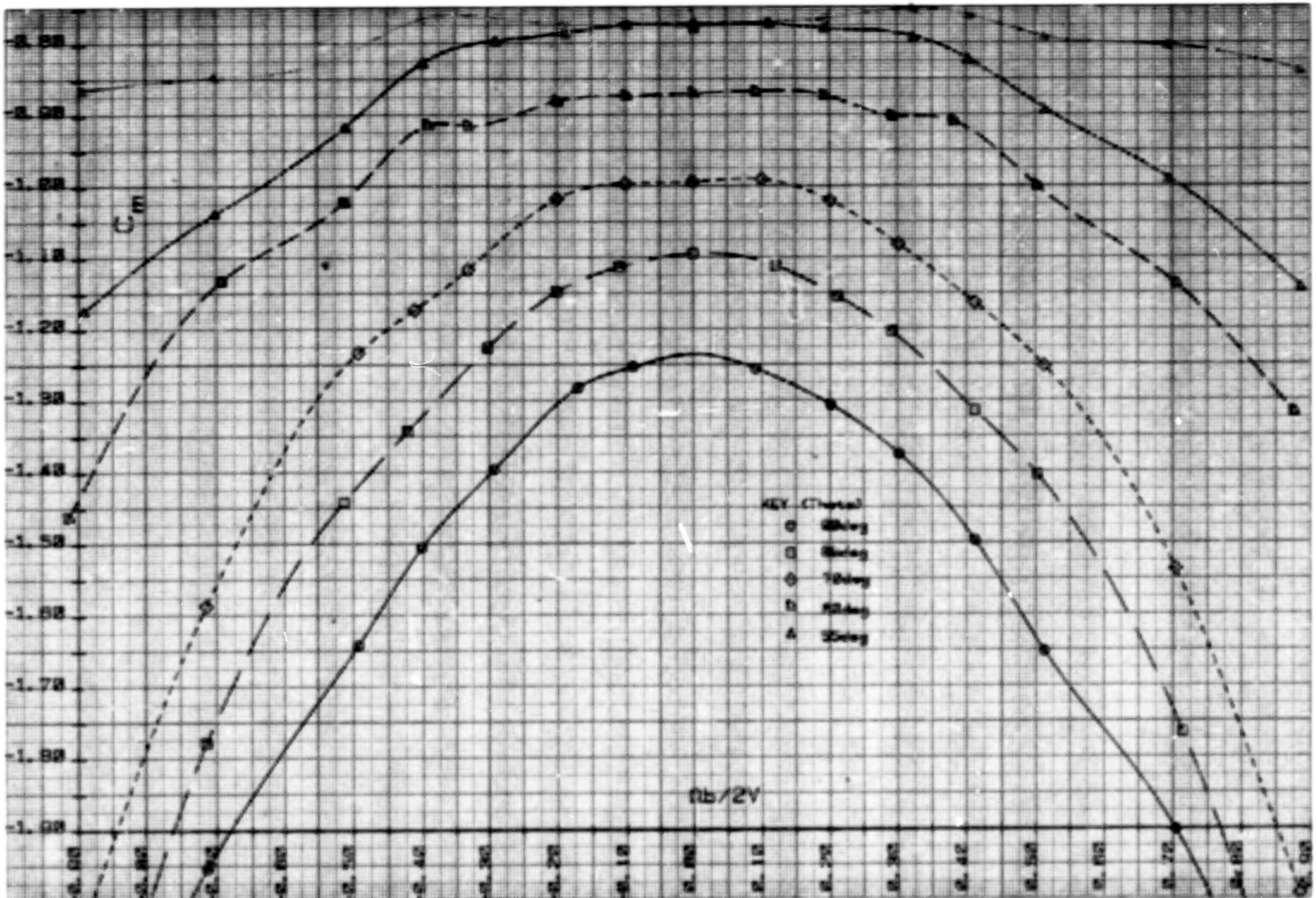
c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi= 0.0deg.

Figure 38. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sc.



d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 38.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sc.



a.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 38. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sc.

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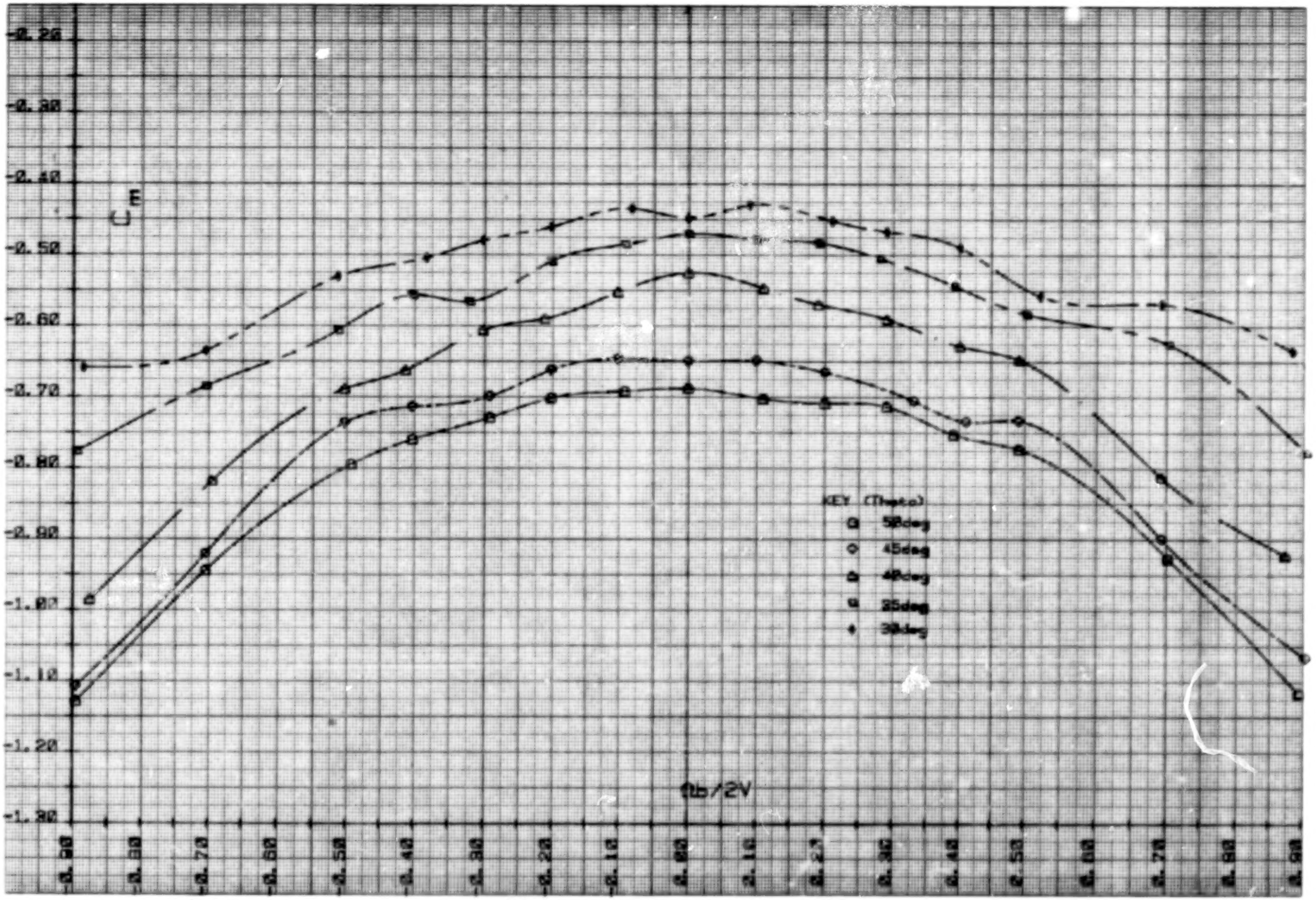
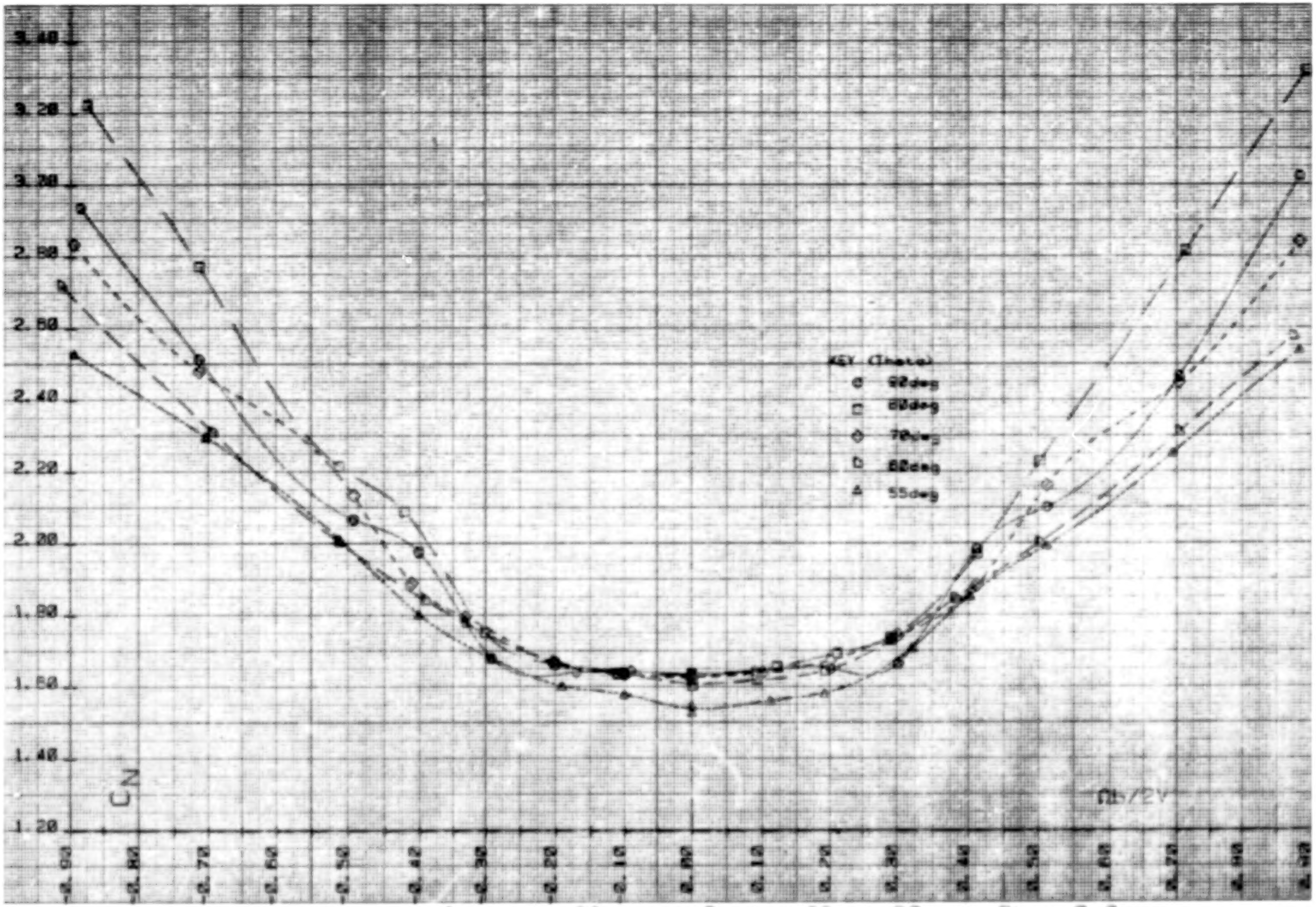


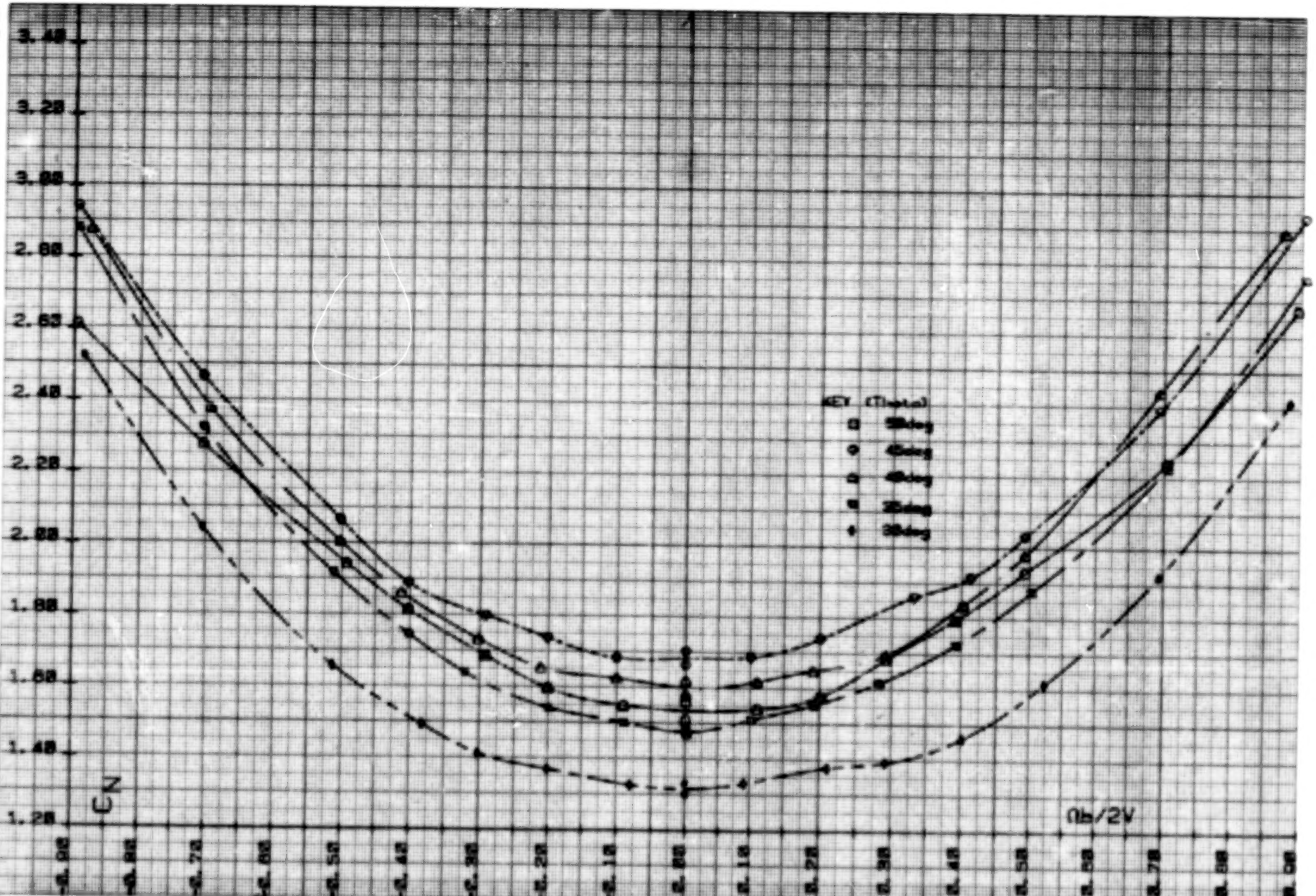
f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 38.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sc.



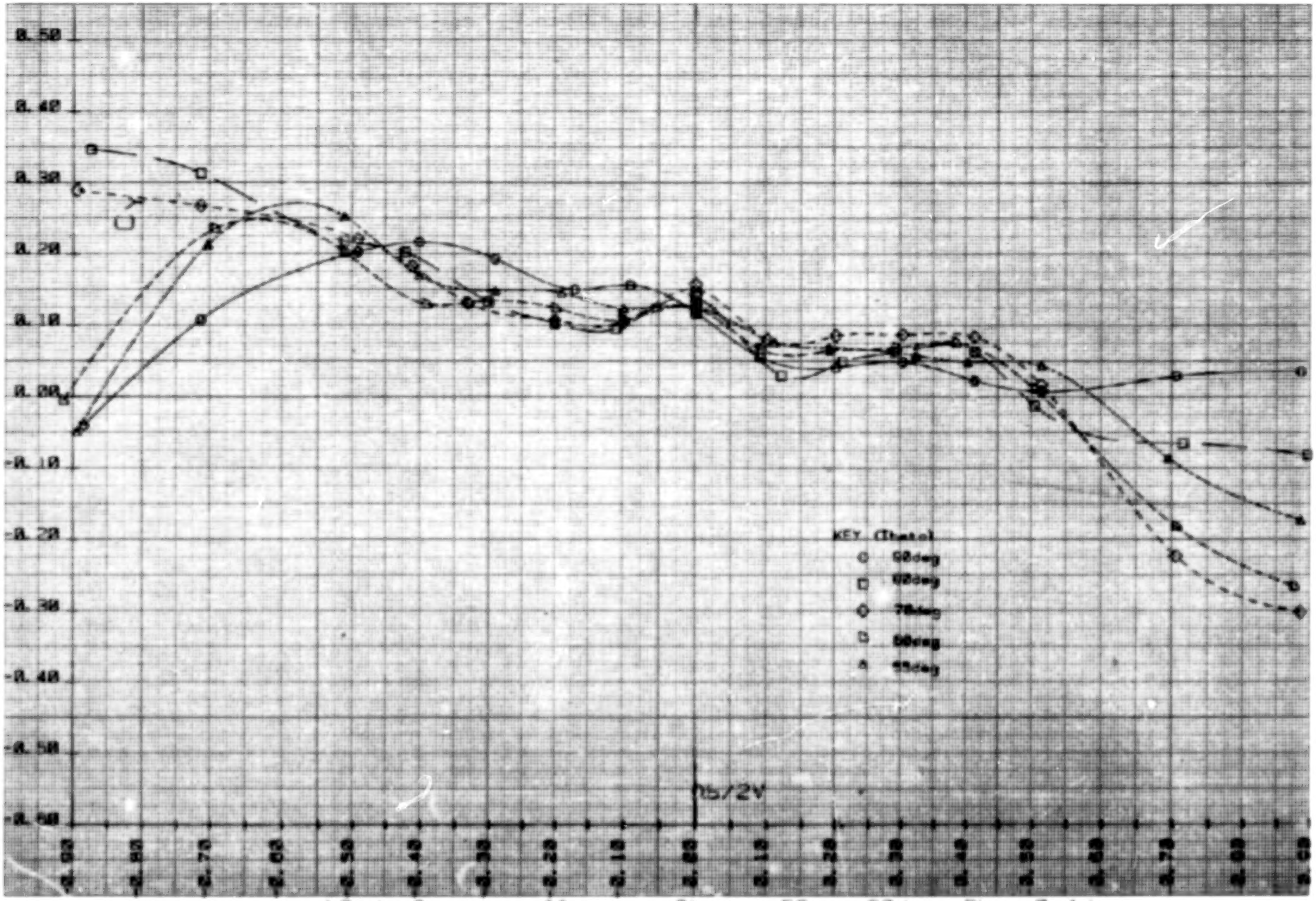
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi= 0.0deg.

Figure 38. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1V1+Sc.



(b.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 38.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sc.



(i.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 38.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sc.

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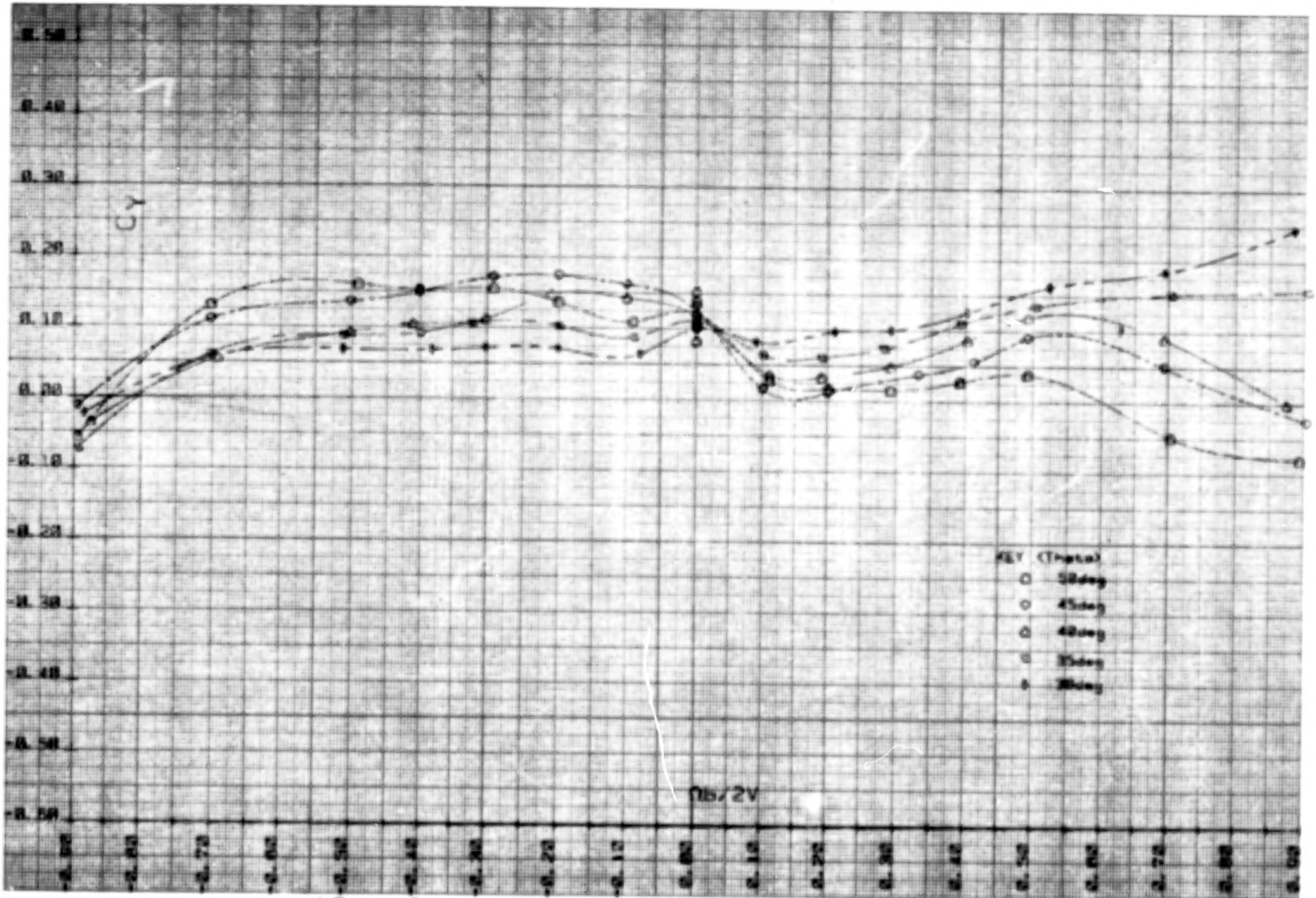
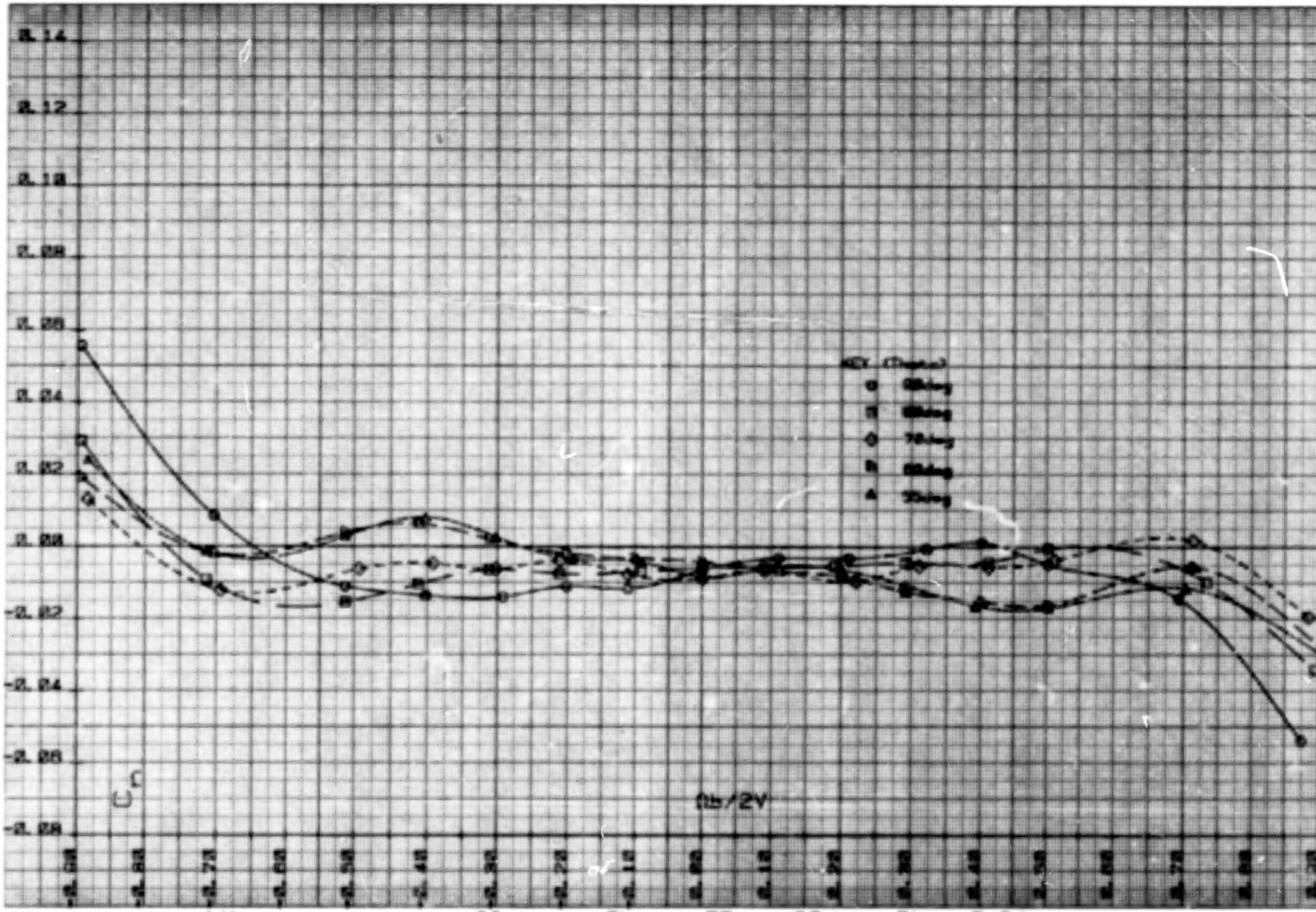


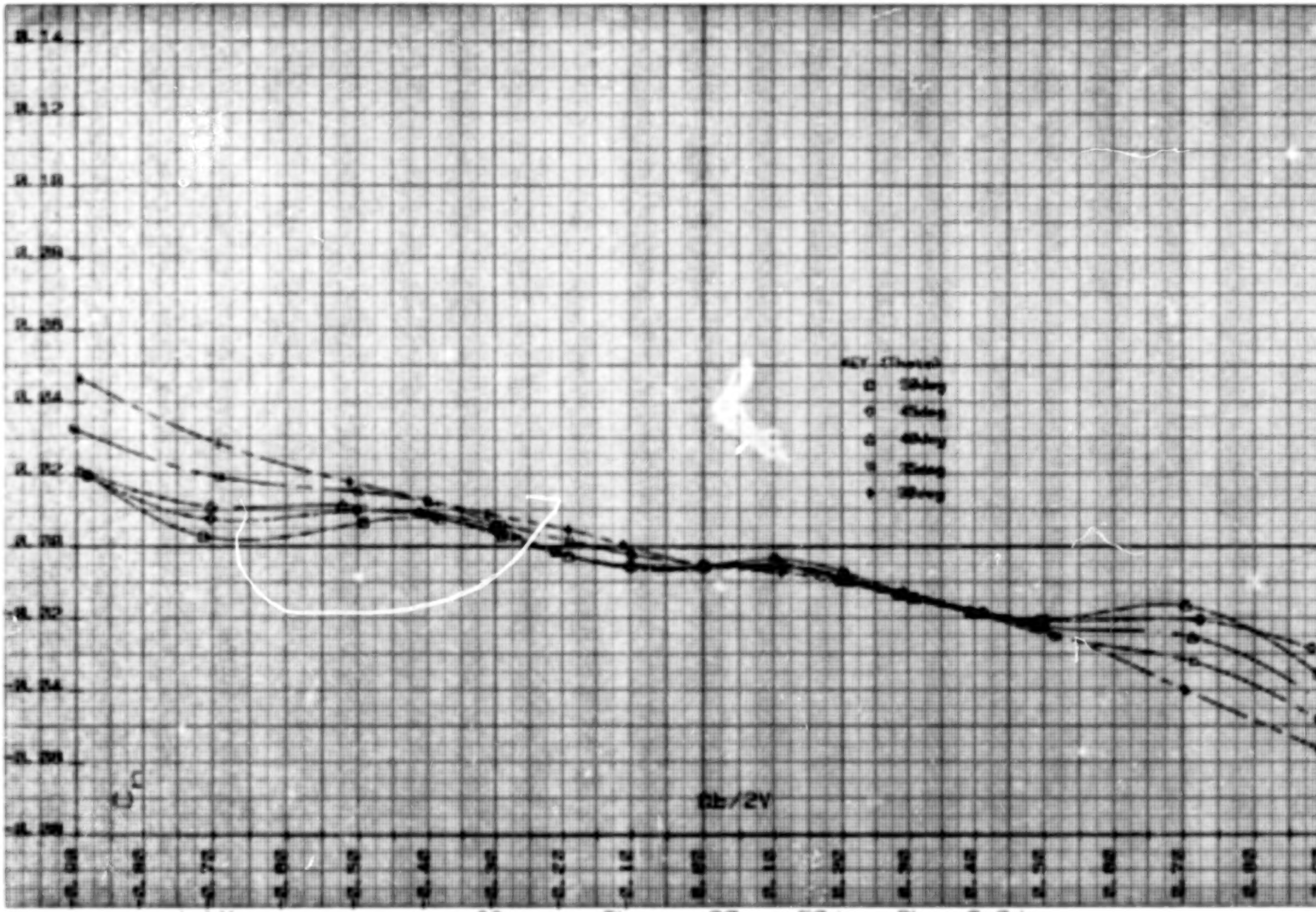
j.) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 38. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sc.



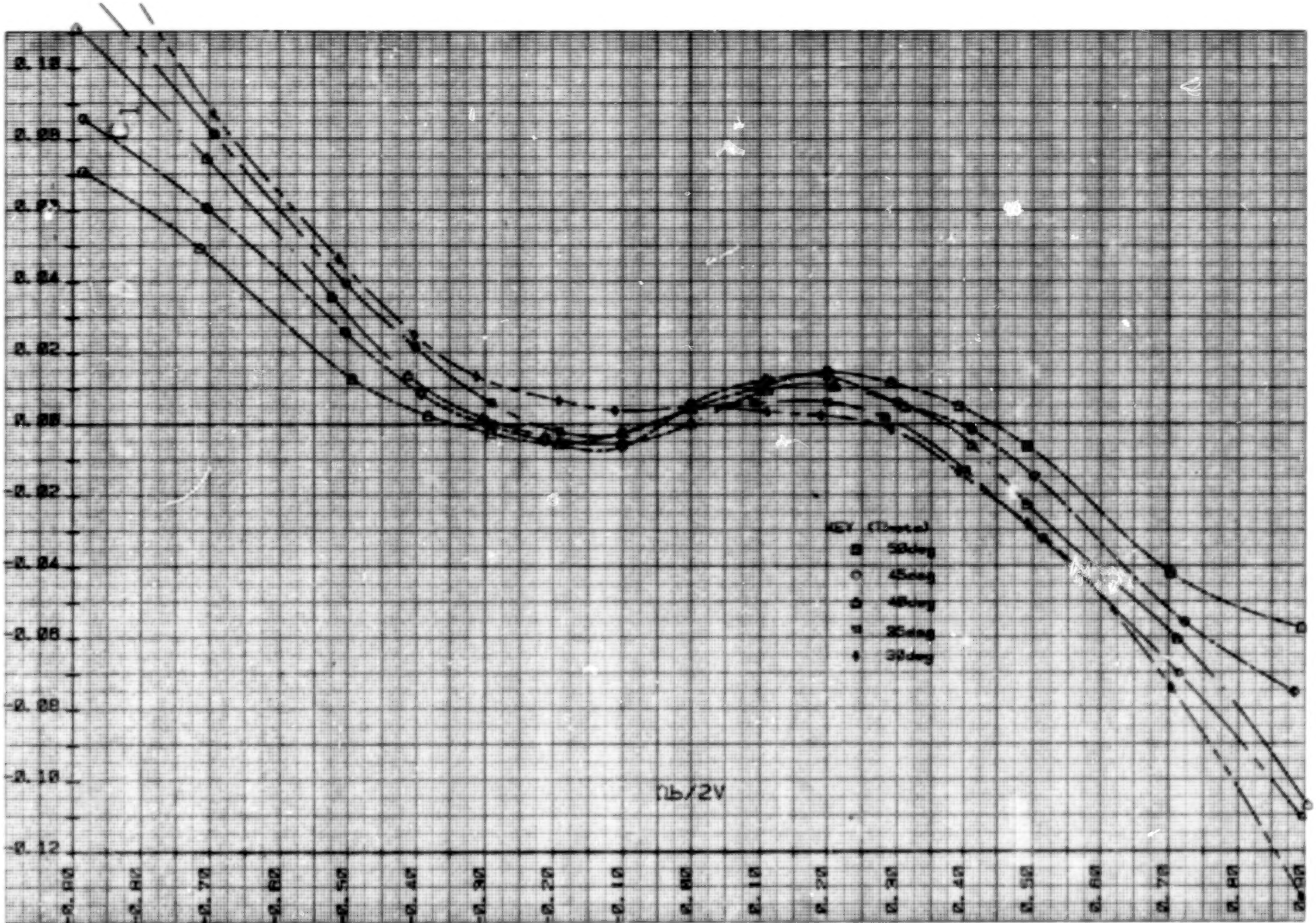
a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 39. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+U.



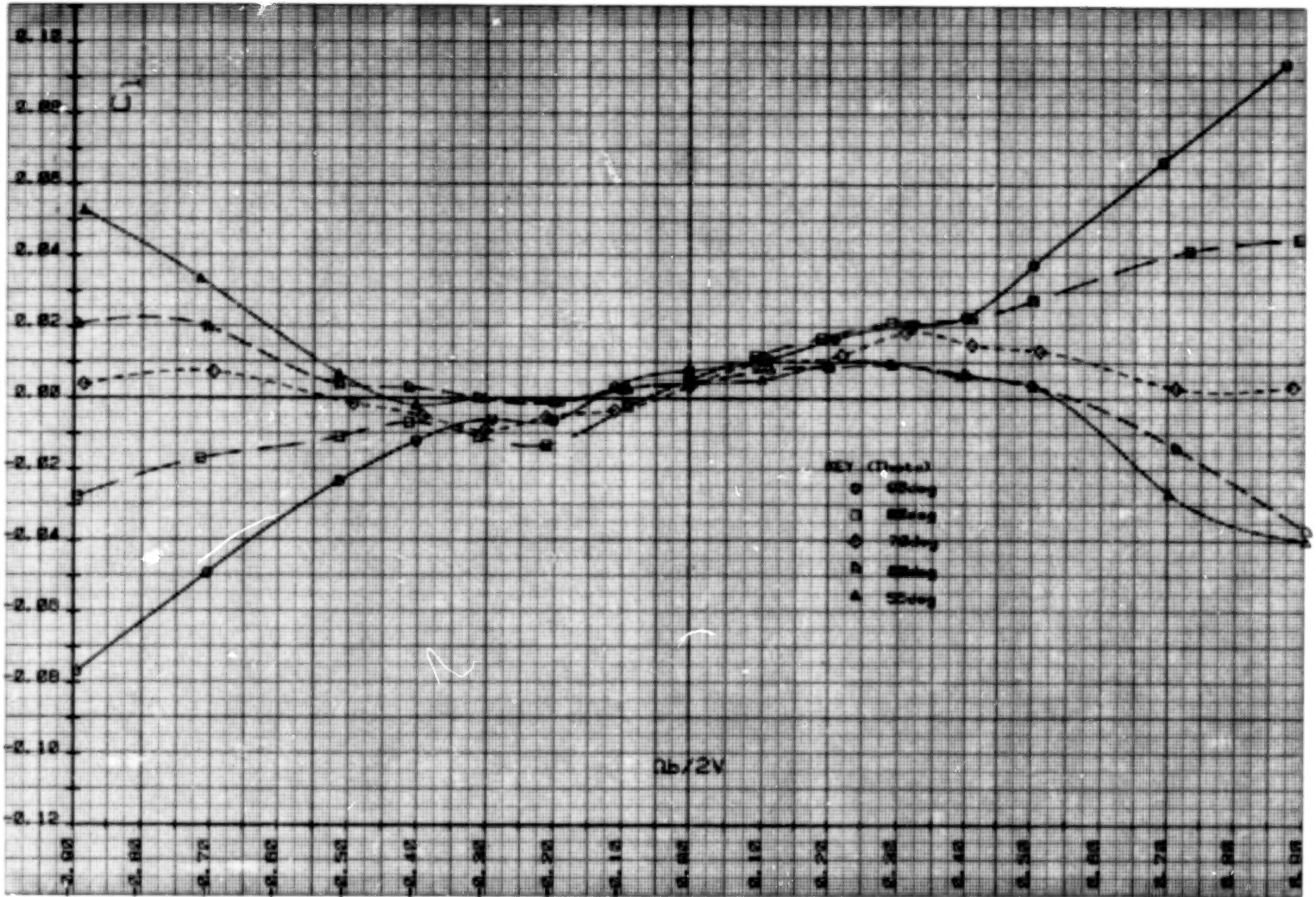
b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.0deg.

Figure 39. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+U.



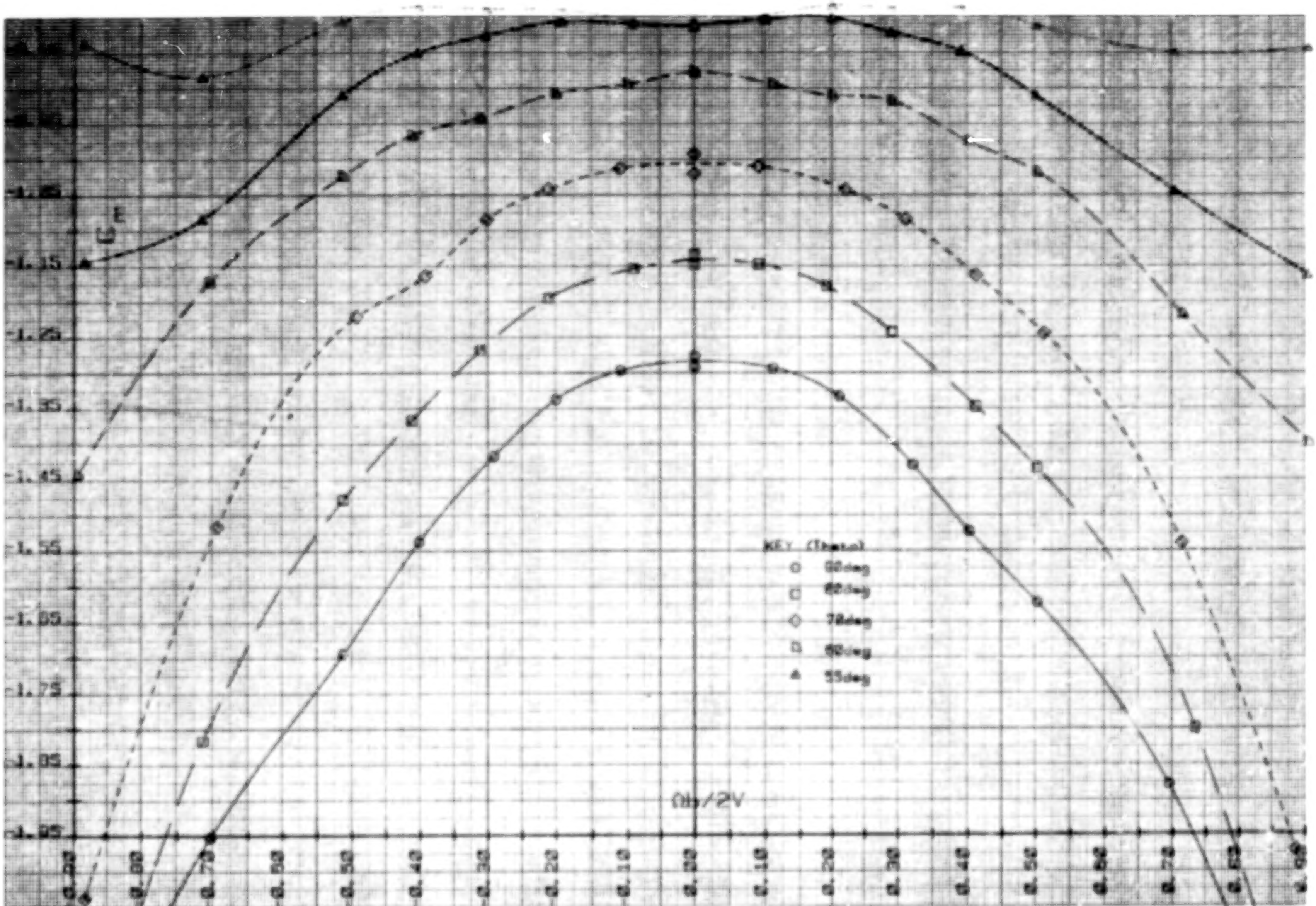
c.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 39. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+U.



d.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.0deg.

Figure 39. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+U.



e.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.0deg.

Figure 39.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+U.

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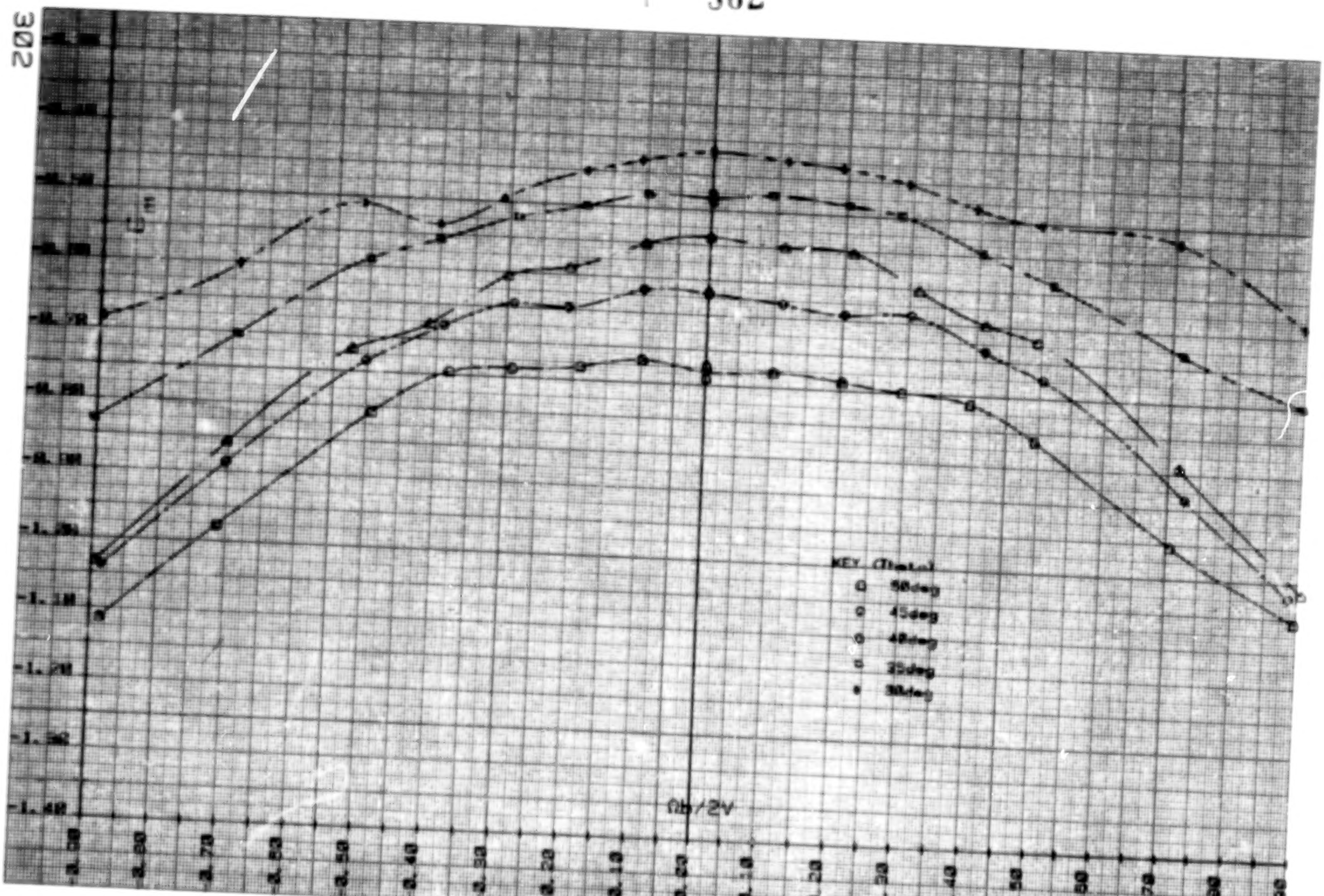
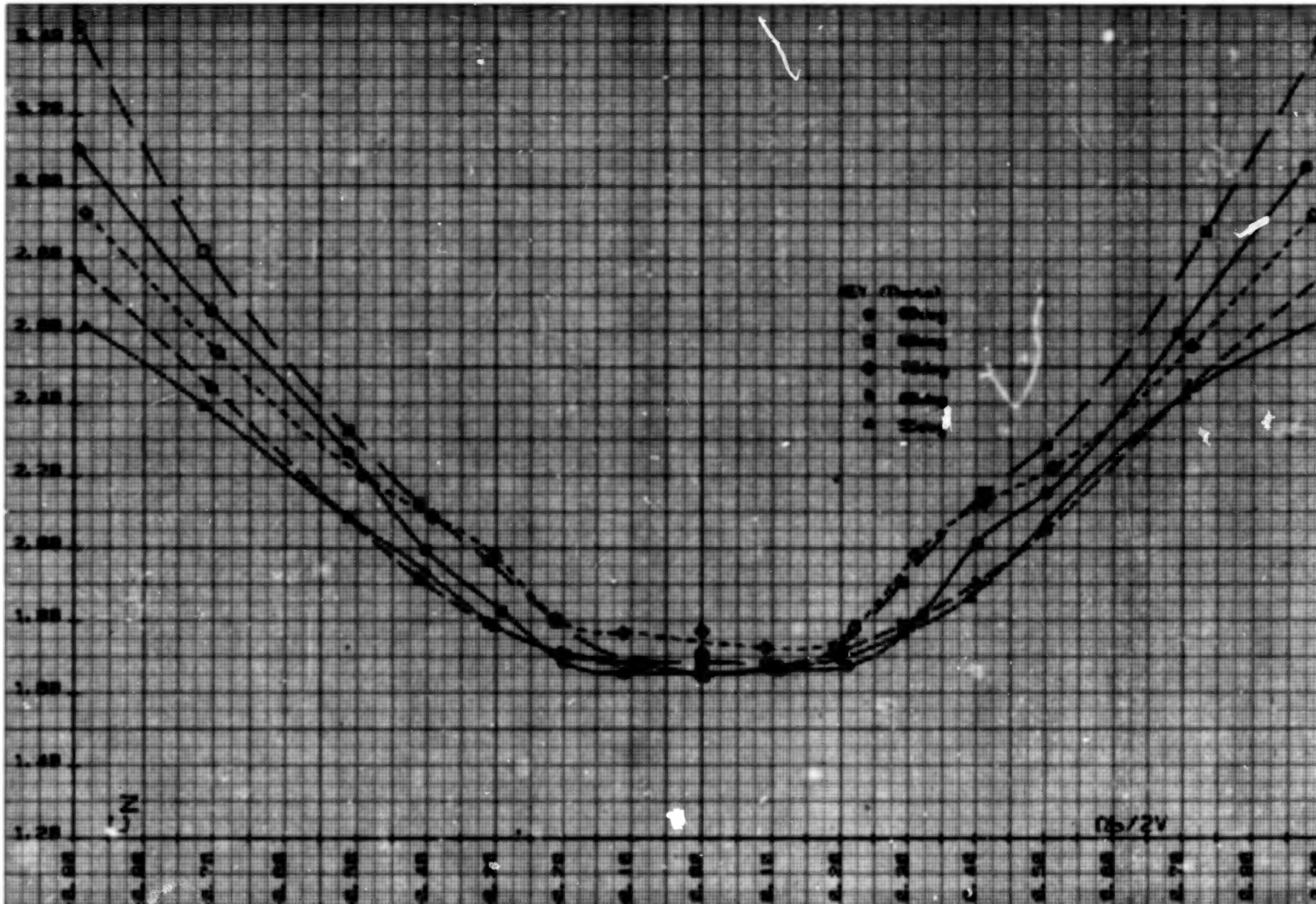


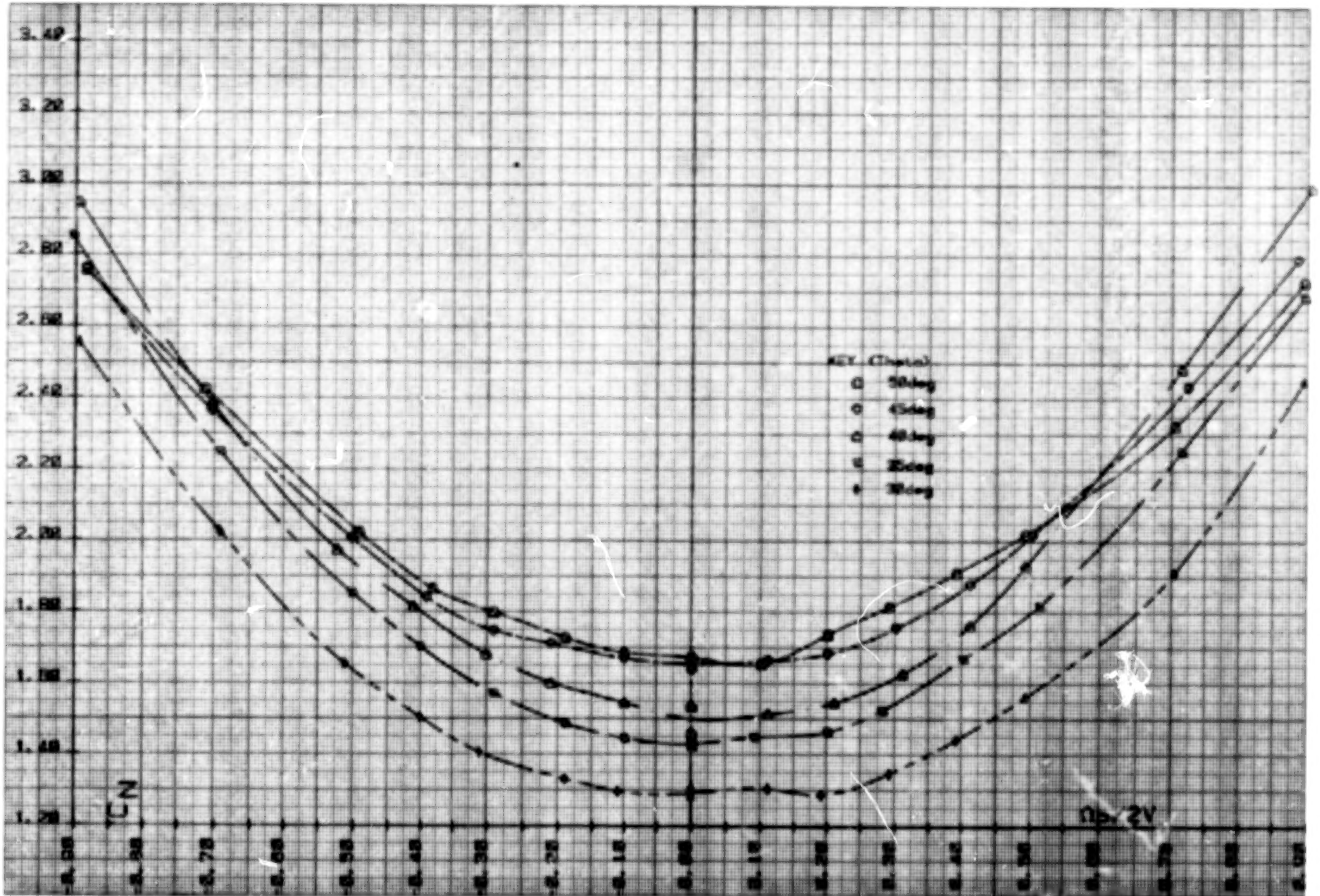
f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 39. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+U.



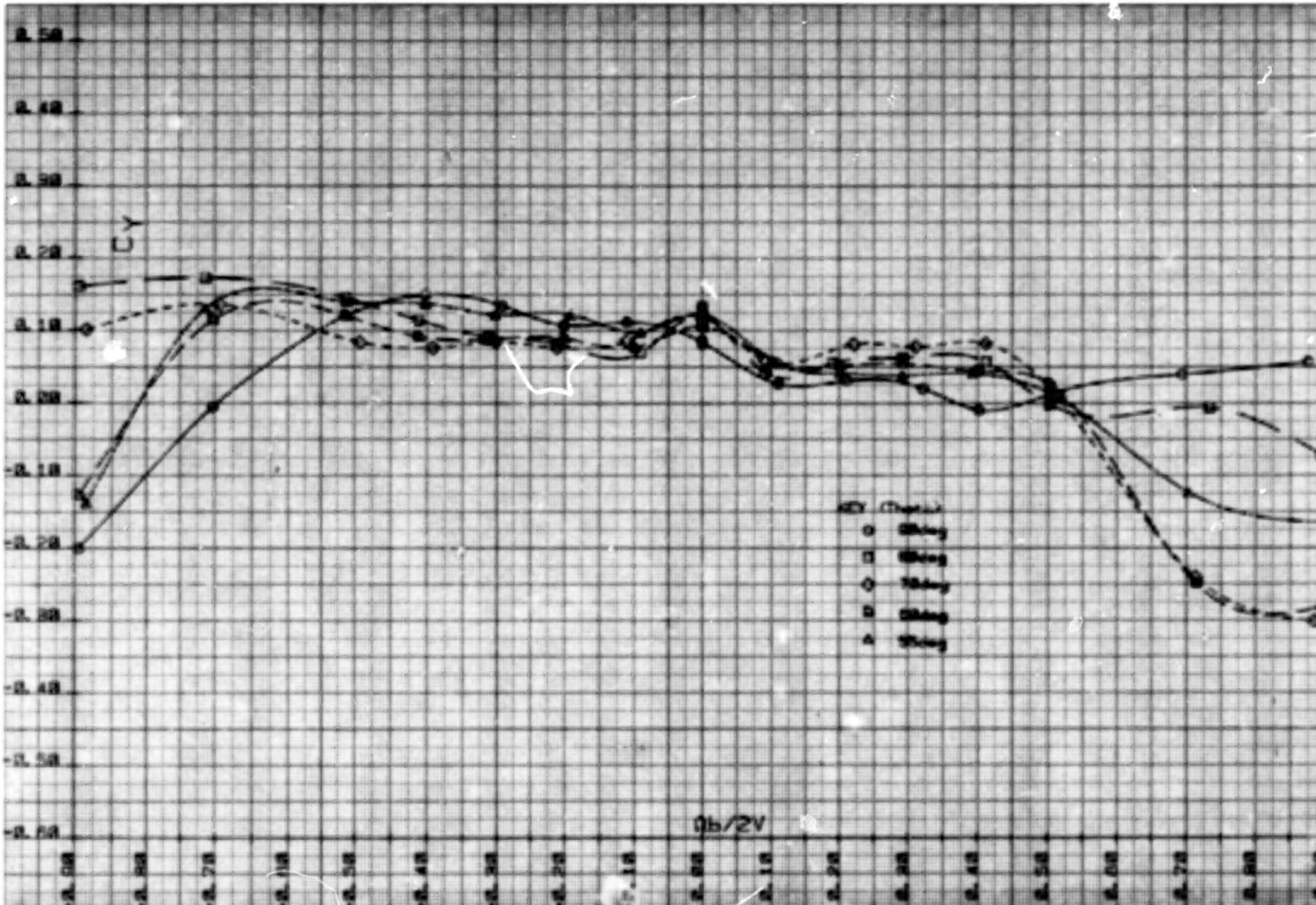
g.) Normal-force coefficient. Theta= 55 to 90deg; Phi=-0.2deg.

Figure 39. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+U.



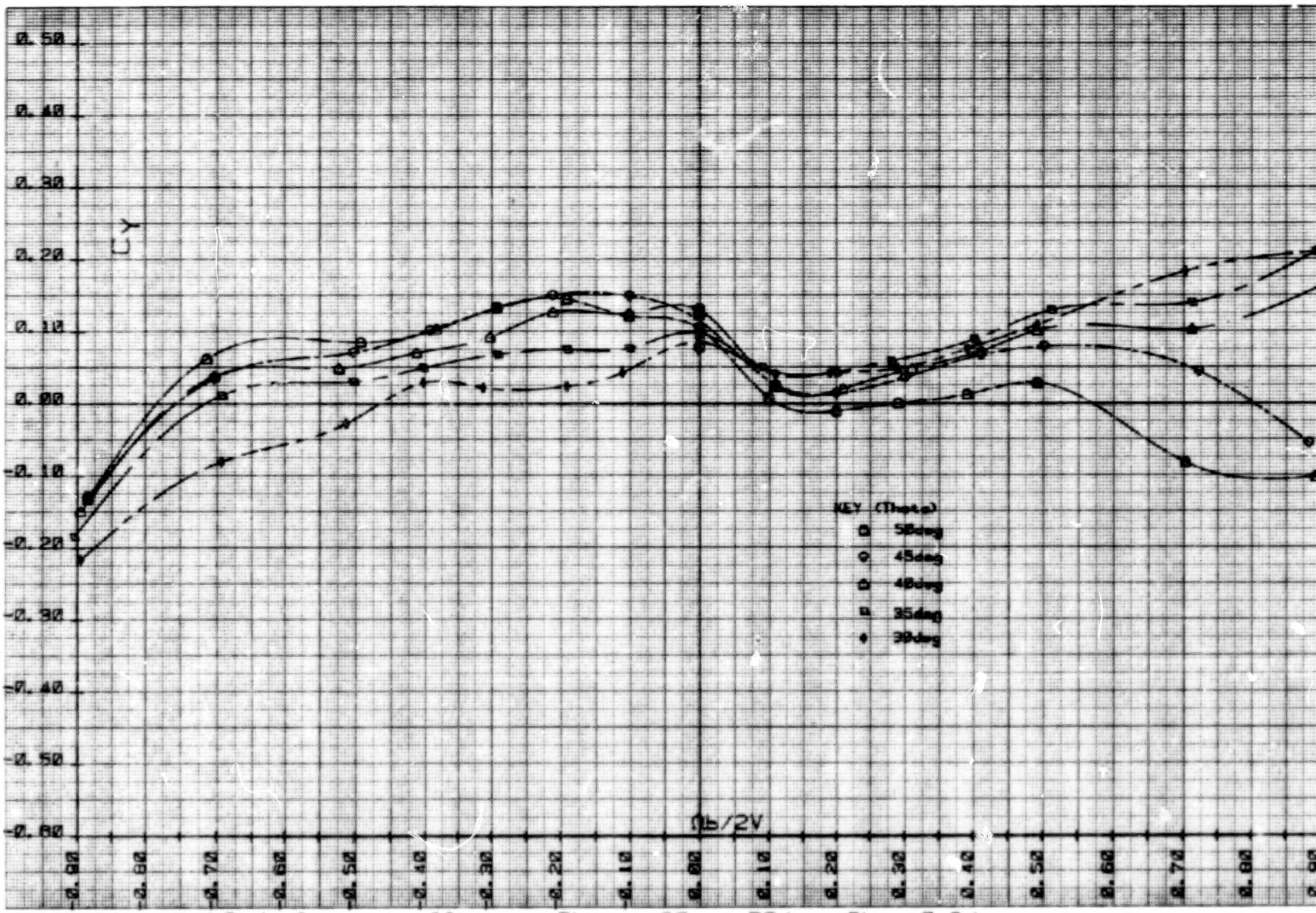
h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.0deg.

Figure 39.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+U.



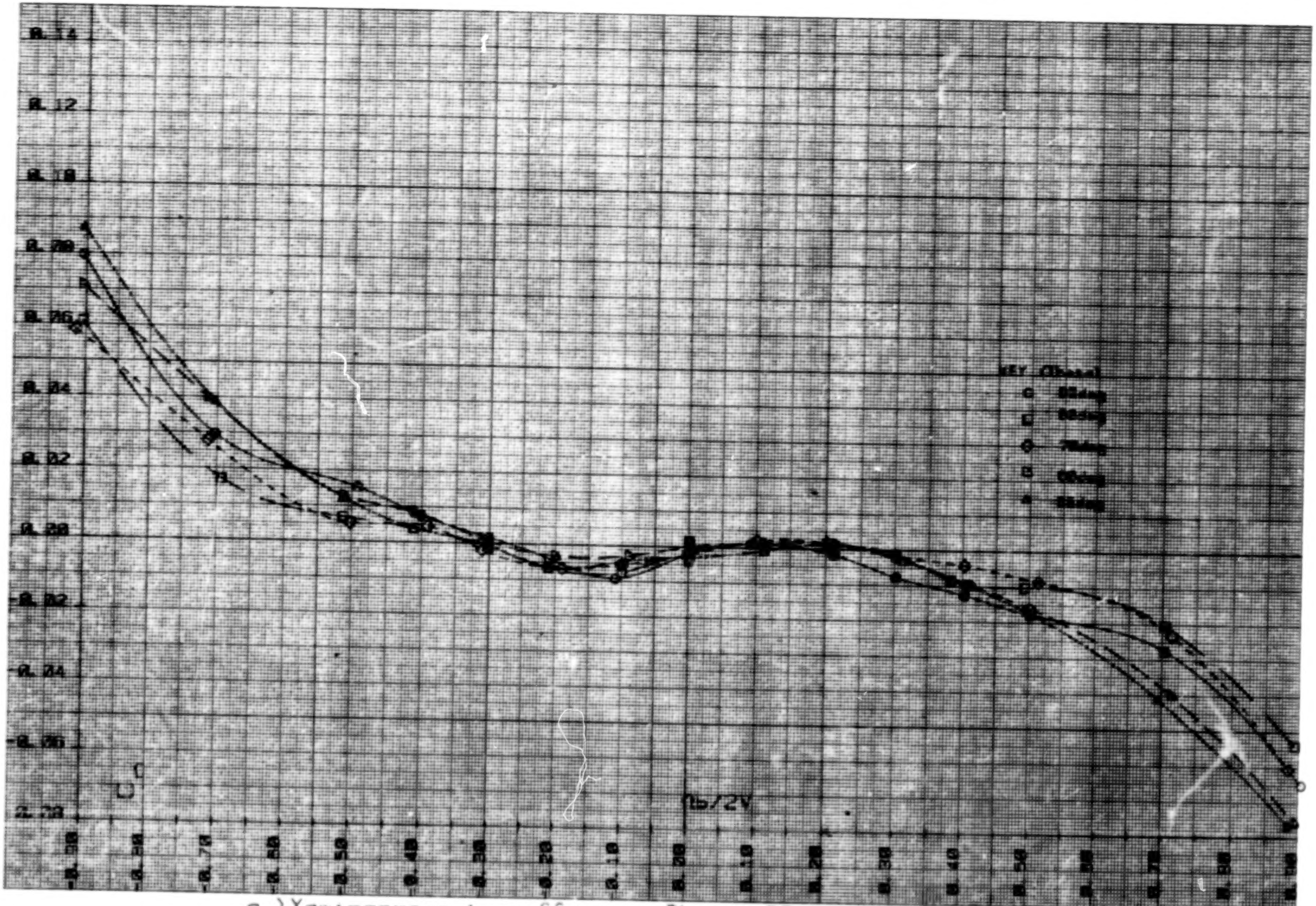
.) Side-force coefficient. Theta= 55 to 90deg; Phi=-0.0deg.

Figure 39. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+U.



( ) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 39. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+U.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 40. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+D.

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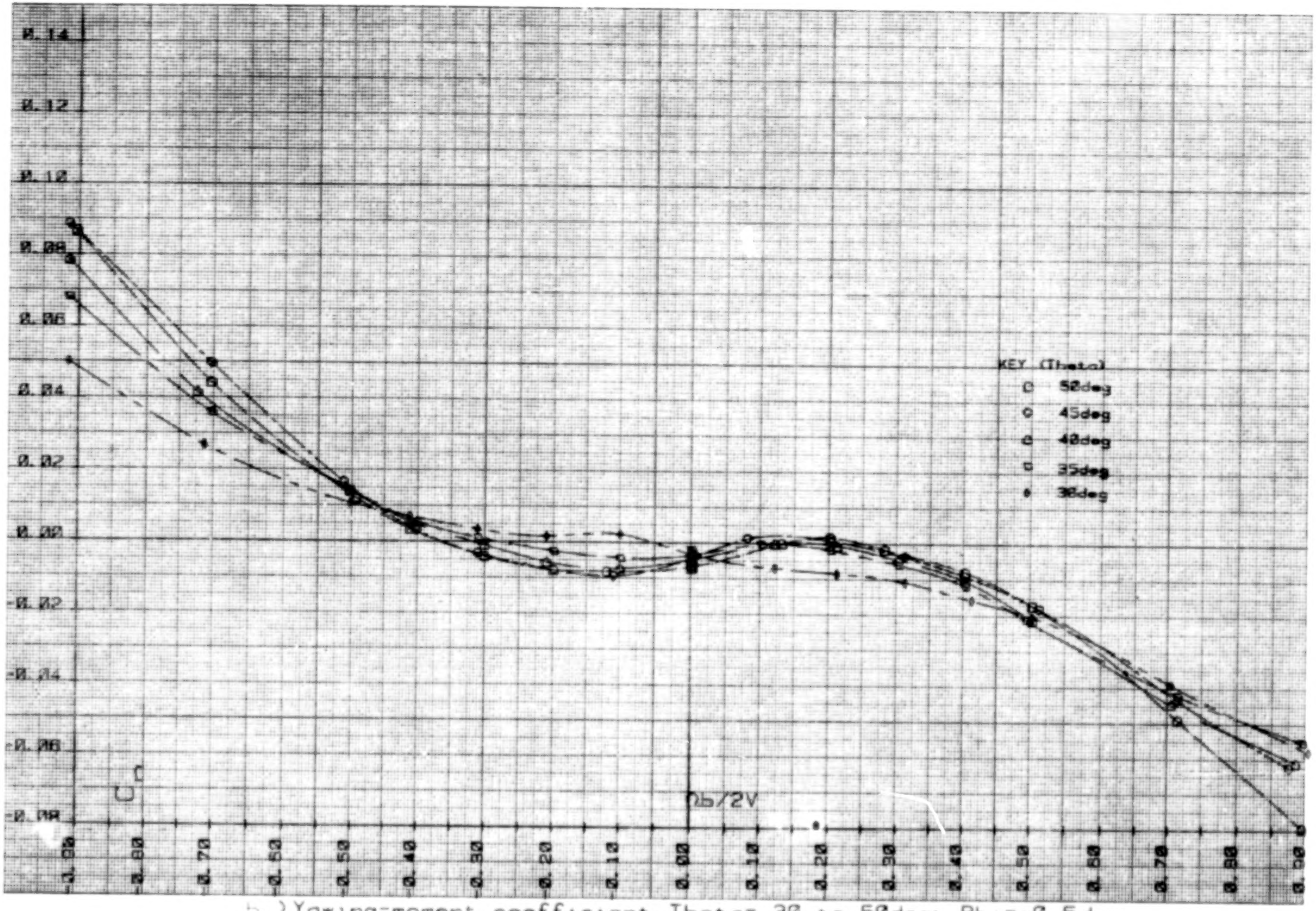
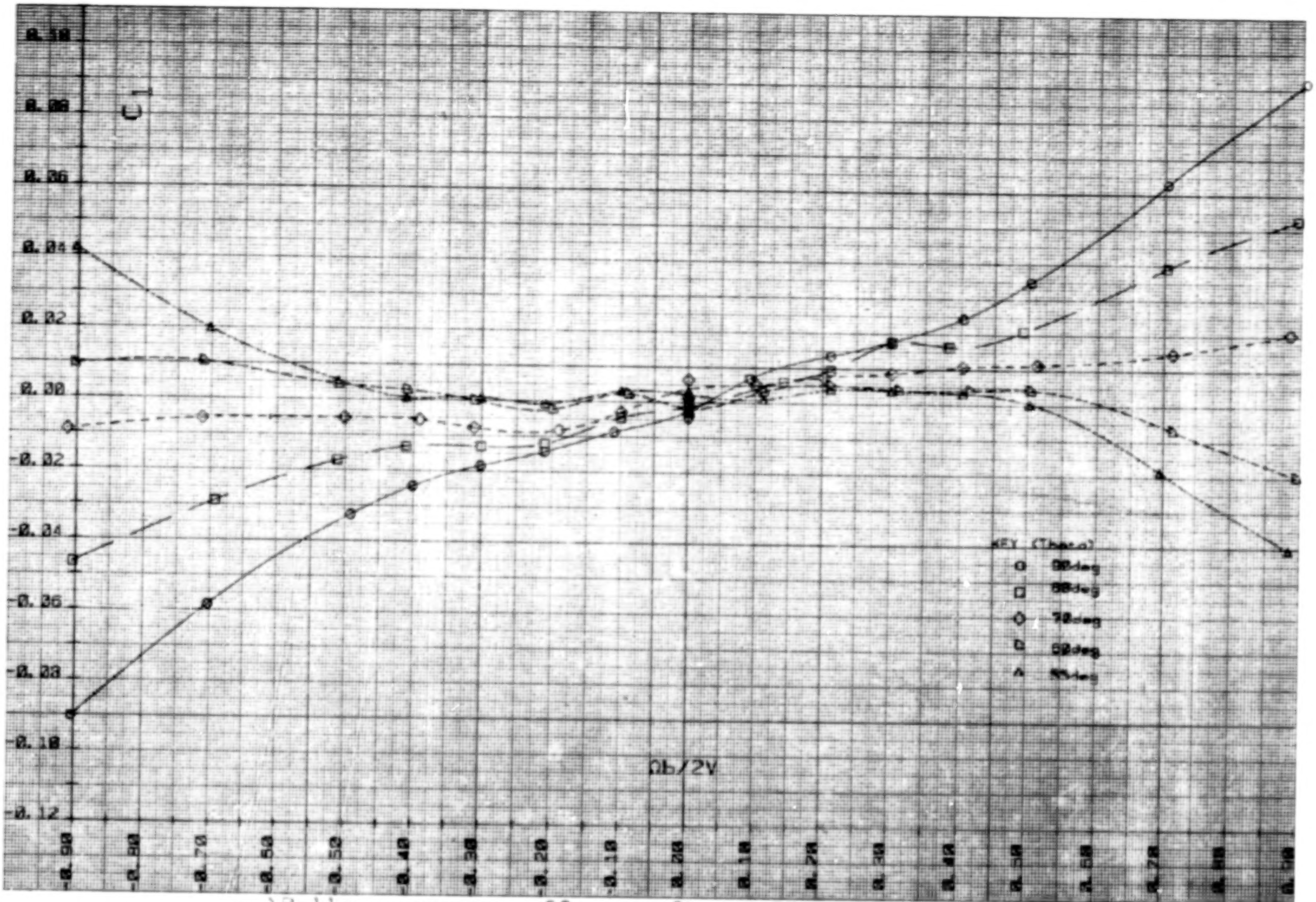


b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.5deg.

Figure 40.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+D.



c.)Rolling-moment coefficient. Theta= 55 to 90dag: Phi=-0.5deg.

Figure 40.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+D.

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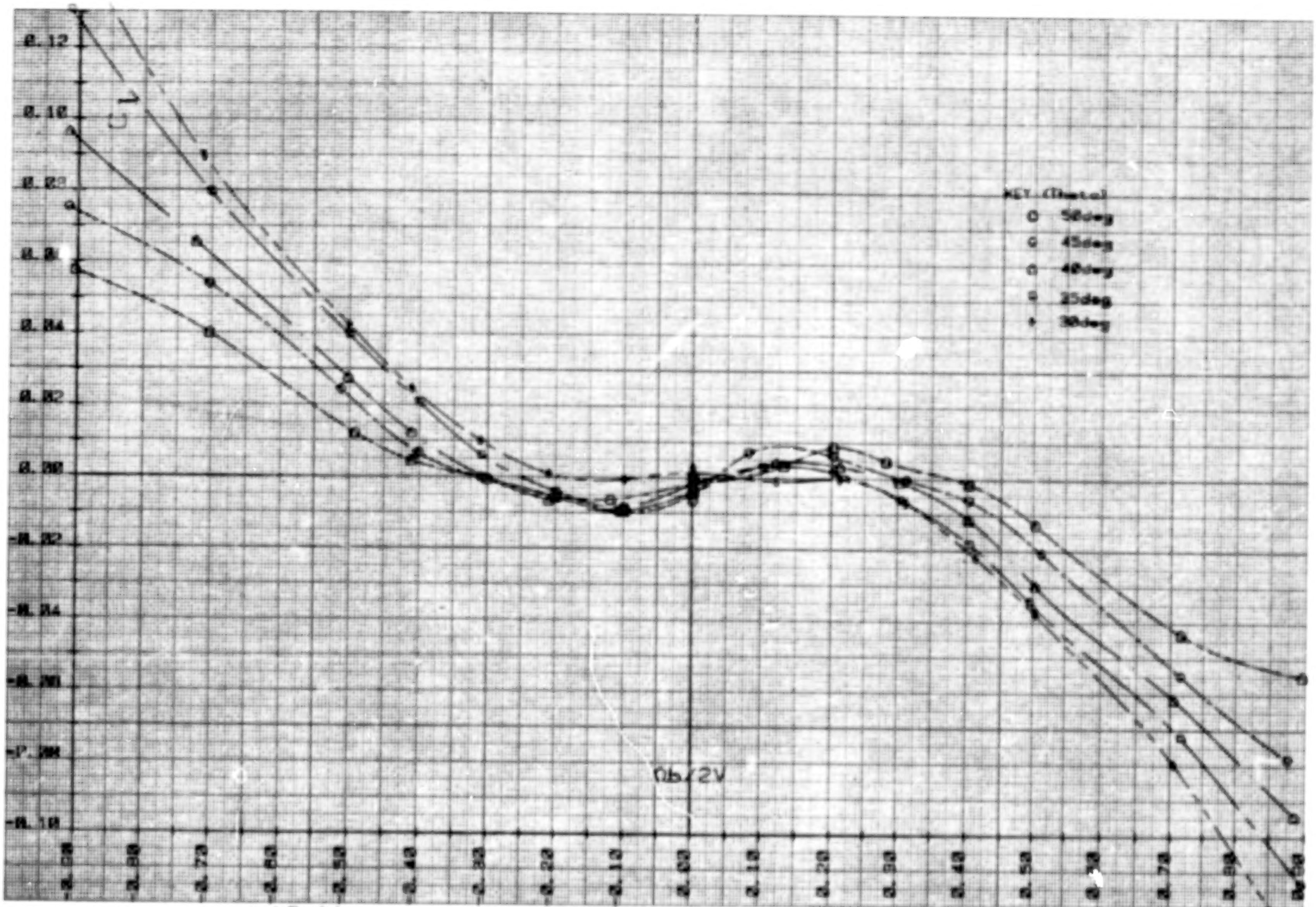
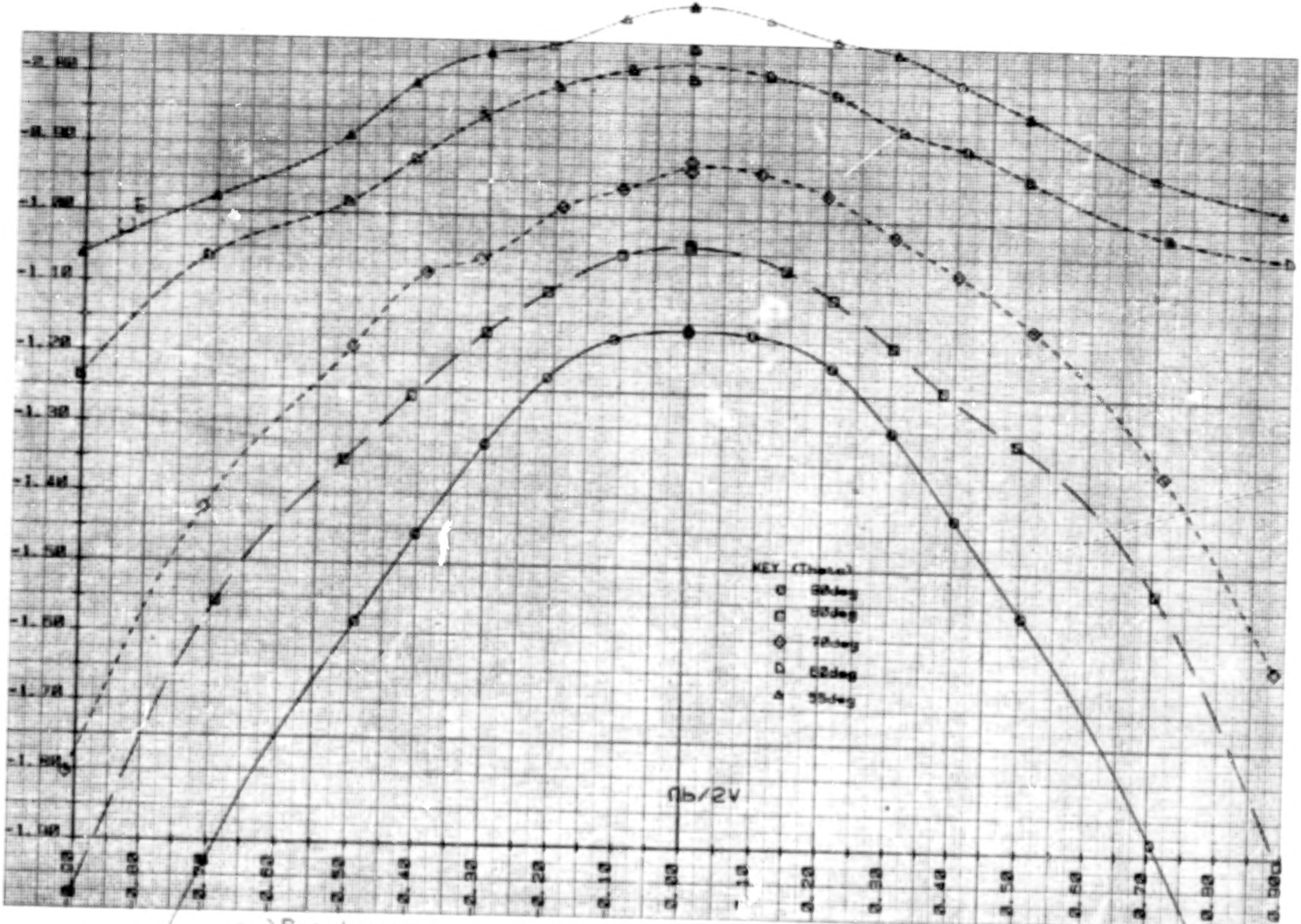


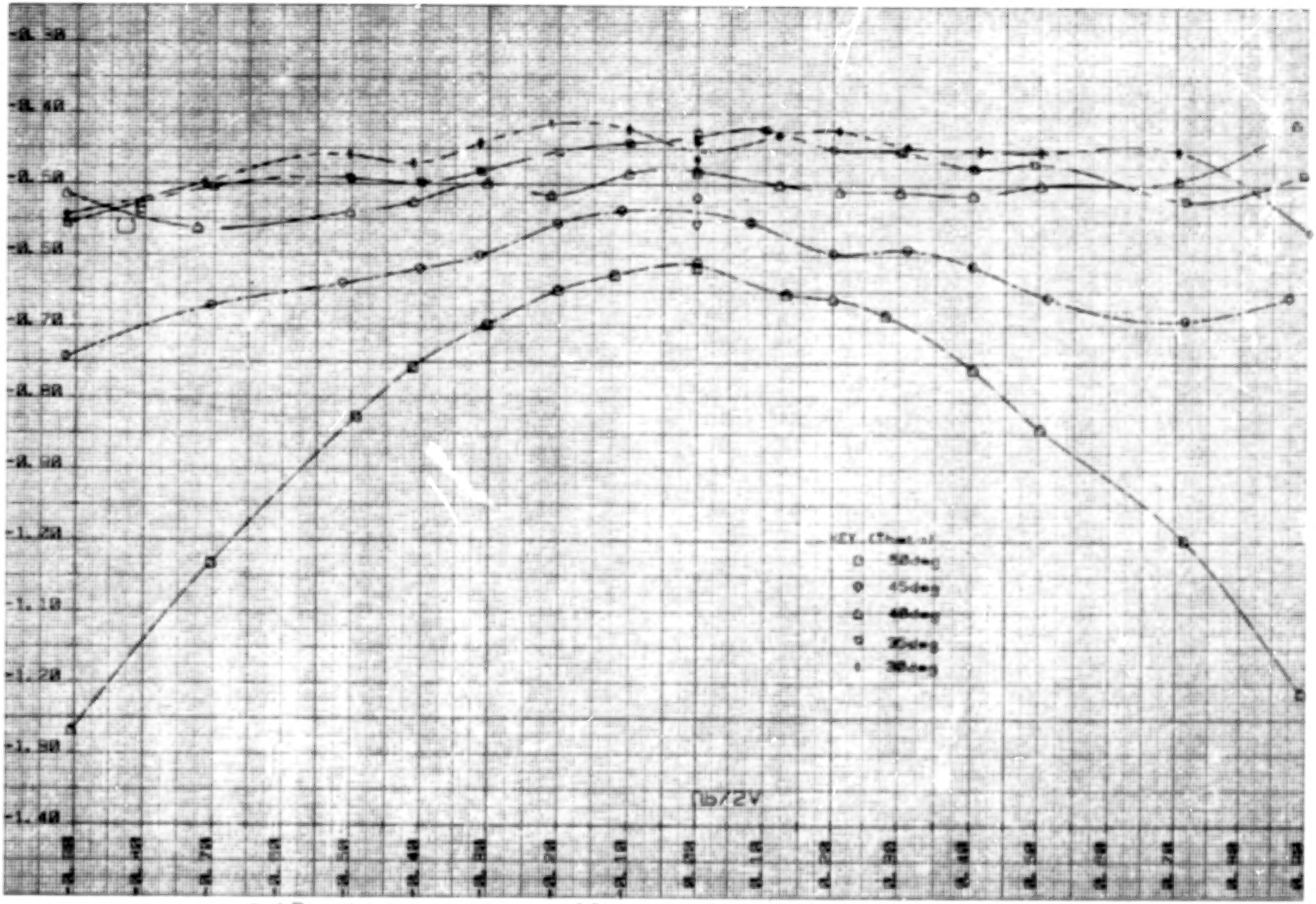
d.) Rolling-moment coefficient. Theta 30 to 50deg; Phi=-0.5deg.

Figure 40. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+D.



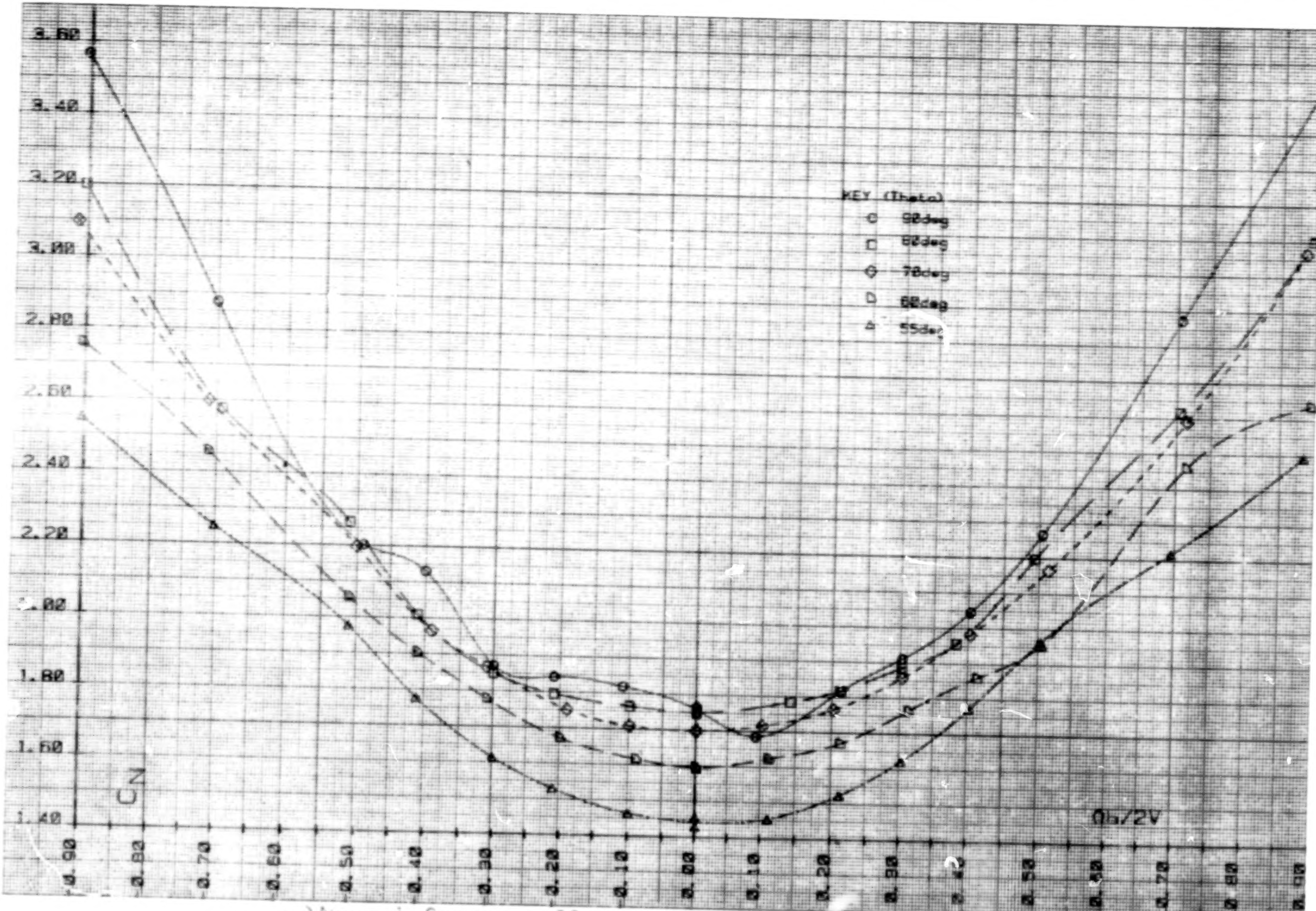
e.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.5deg.

Figure 40. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+D.



f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 40. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+D.



g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 40.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+D.

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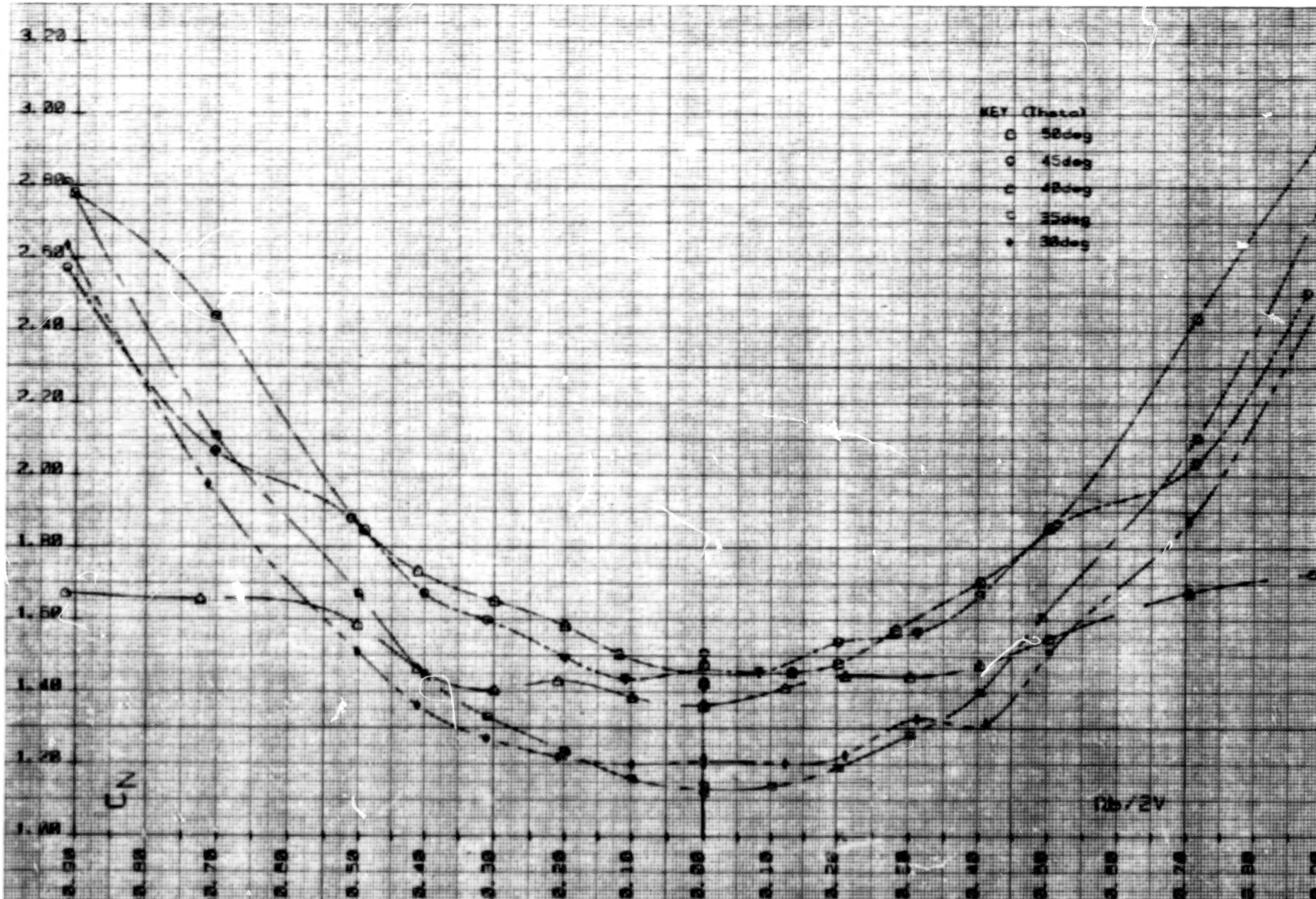
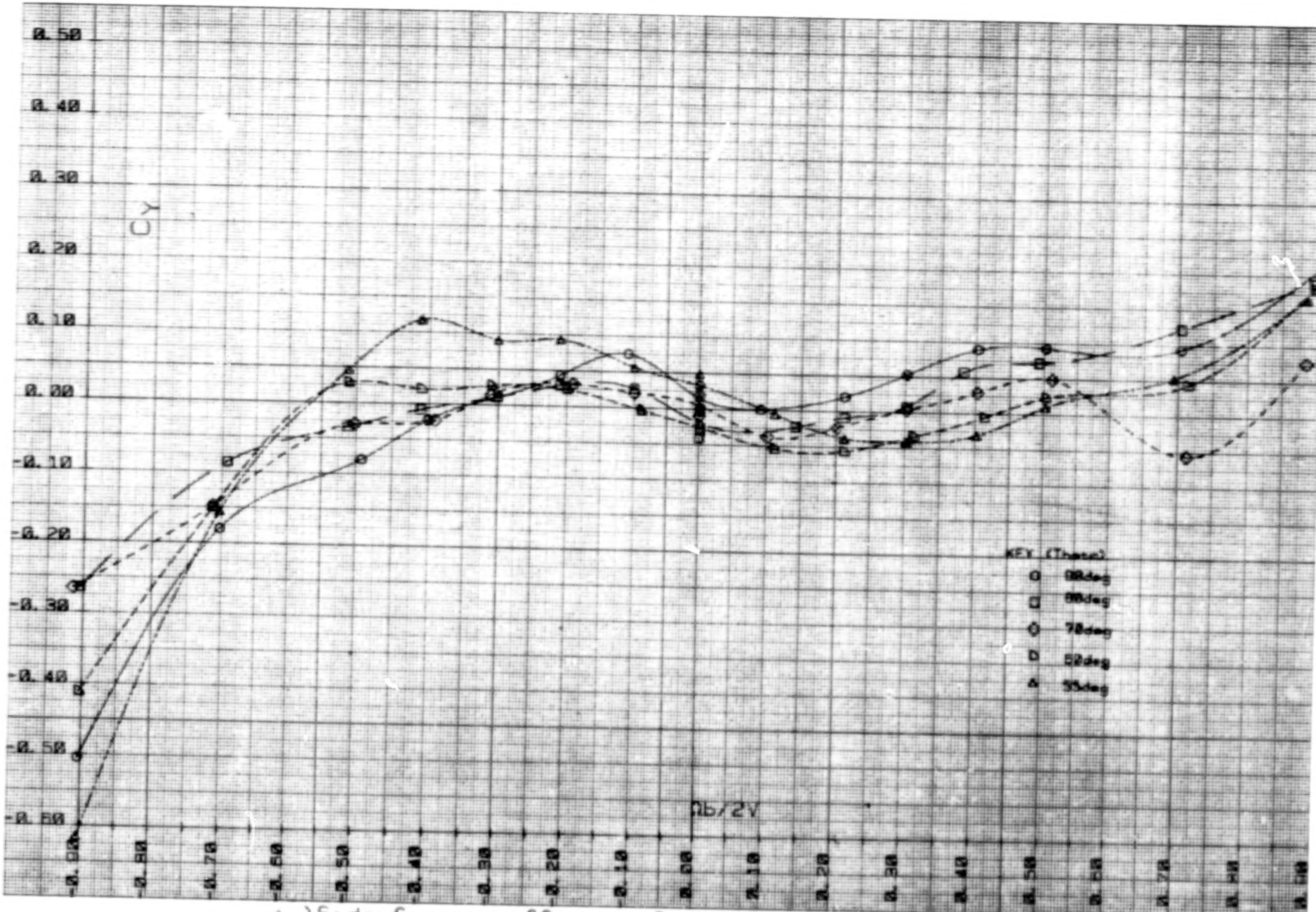


h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 40.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+D.



i.) Side-force coefficient. Theta= 55 to 90deg: Phi=-0.5deg.

Figure 40. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+D.

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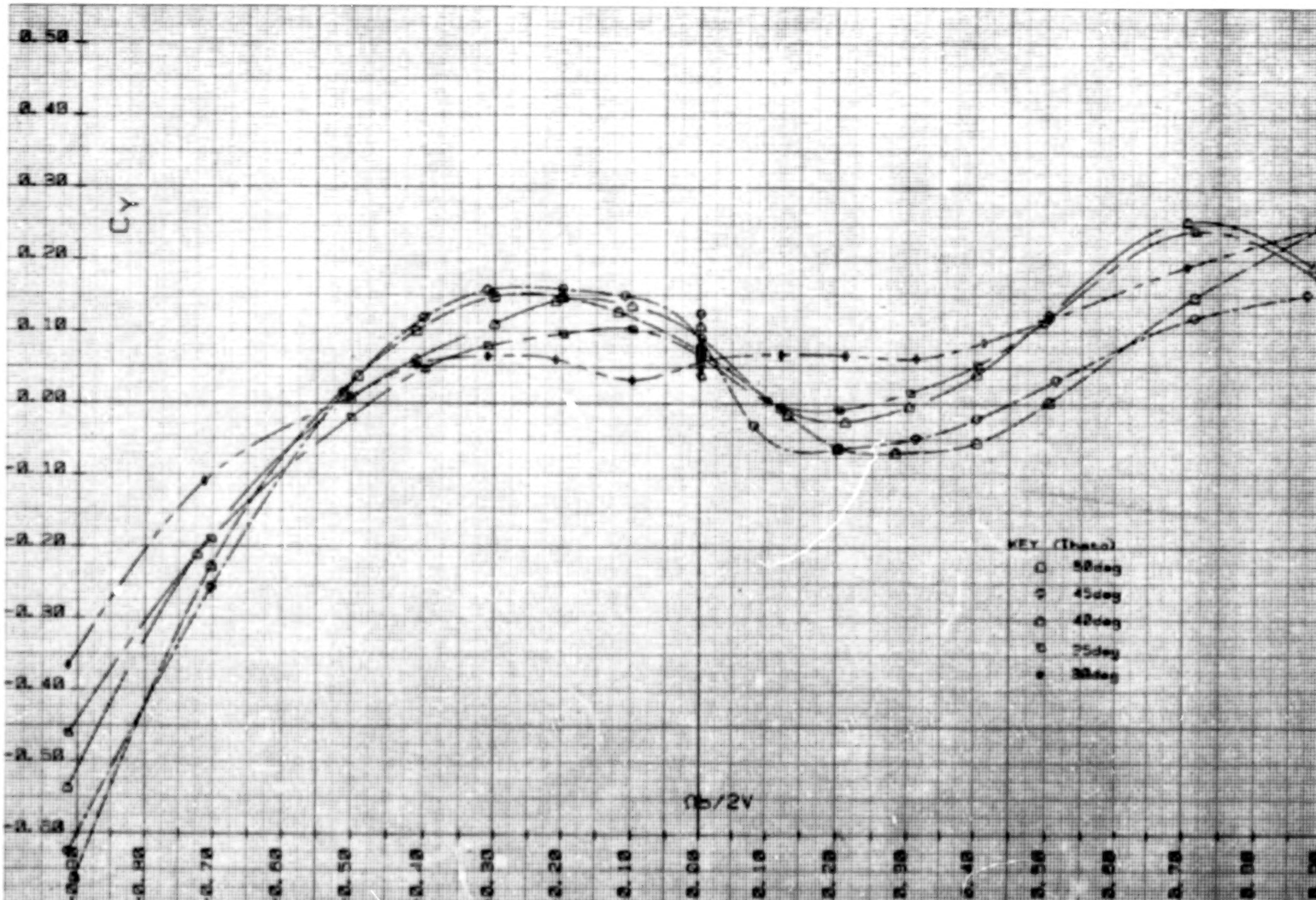
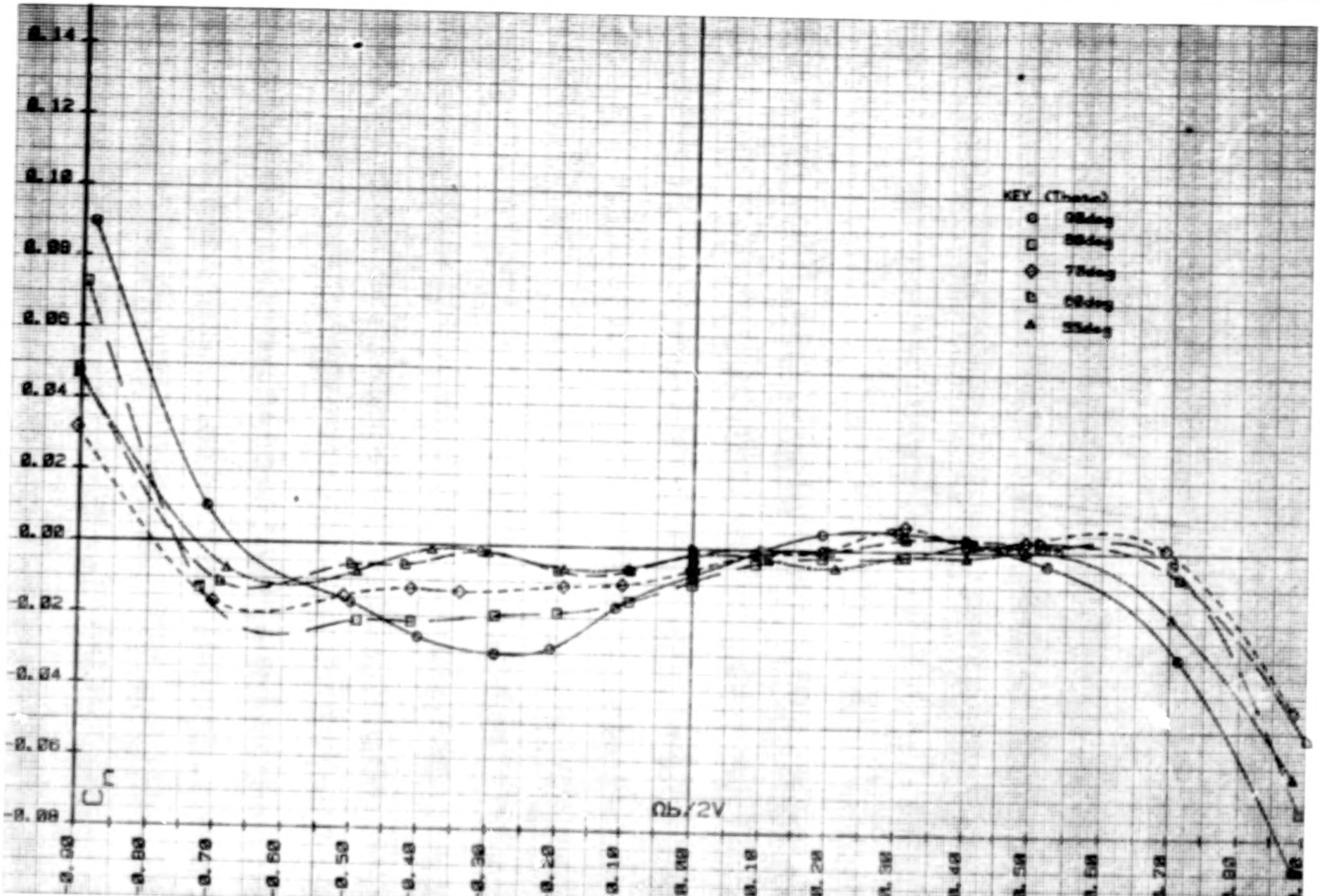


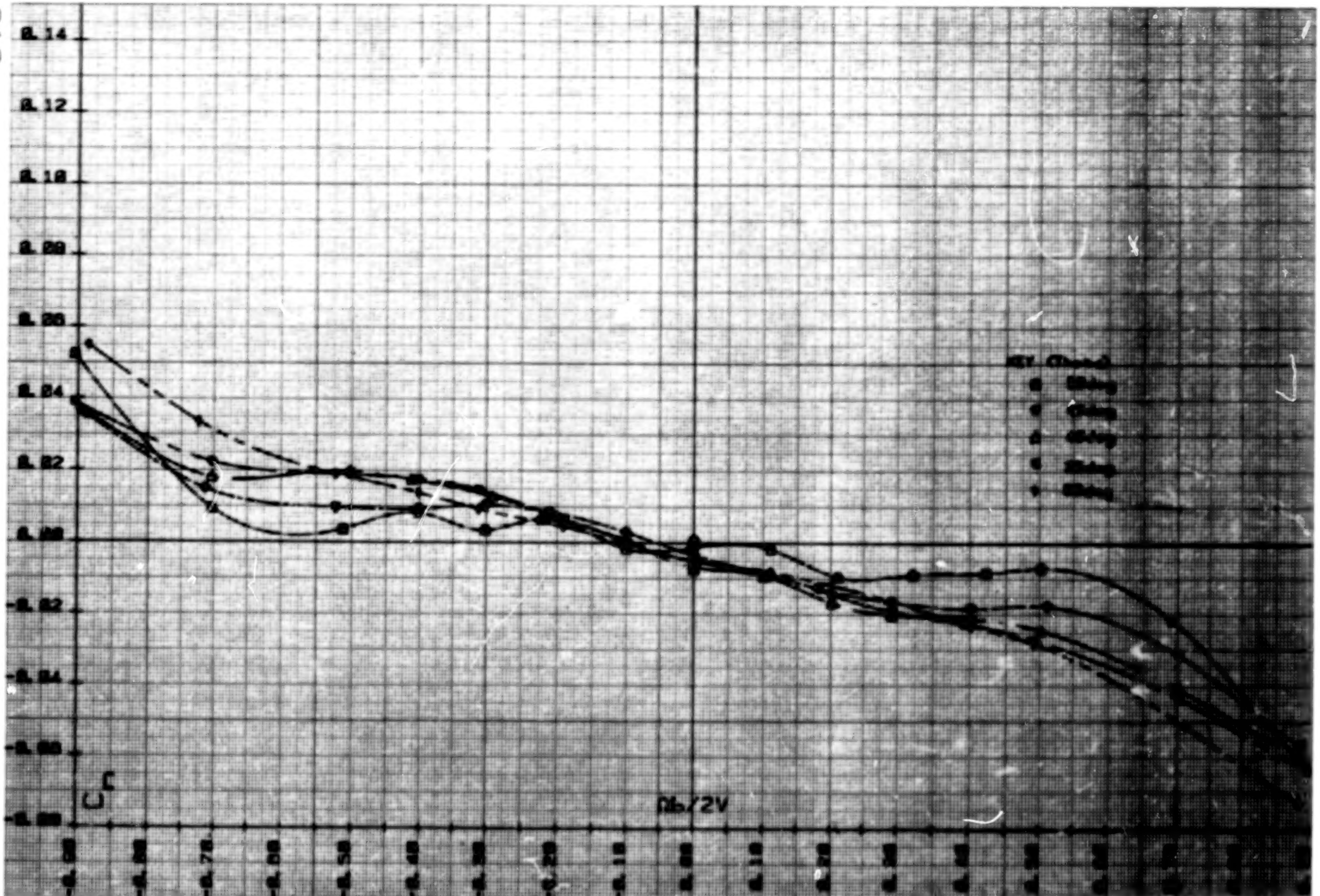
(j.) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.5deg.

Figure 40.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+D.



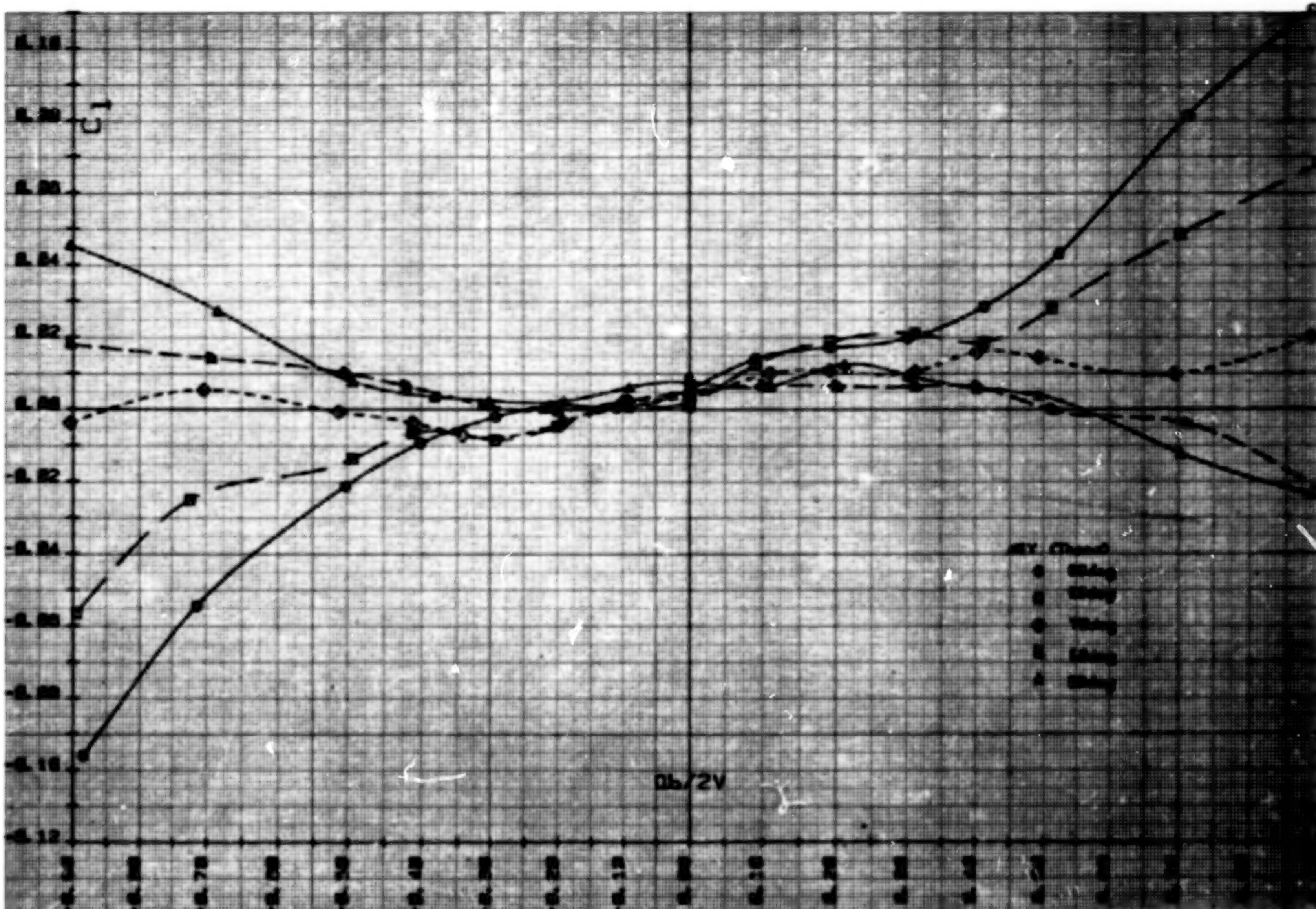
a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 41. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+E.



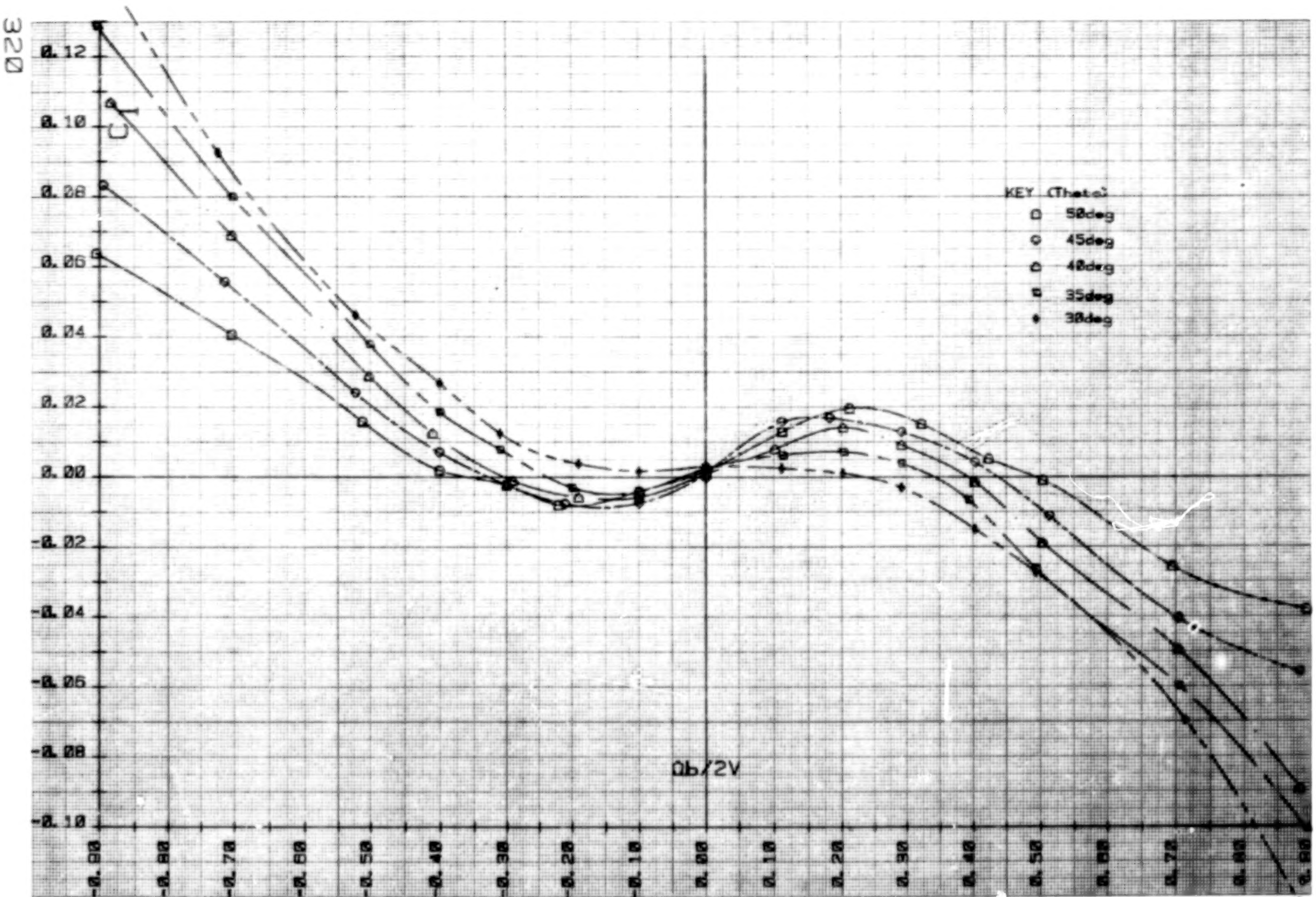
b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 41.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+E.



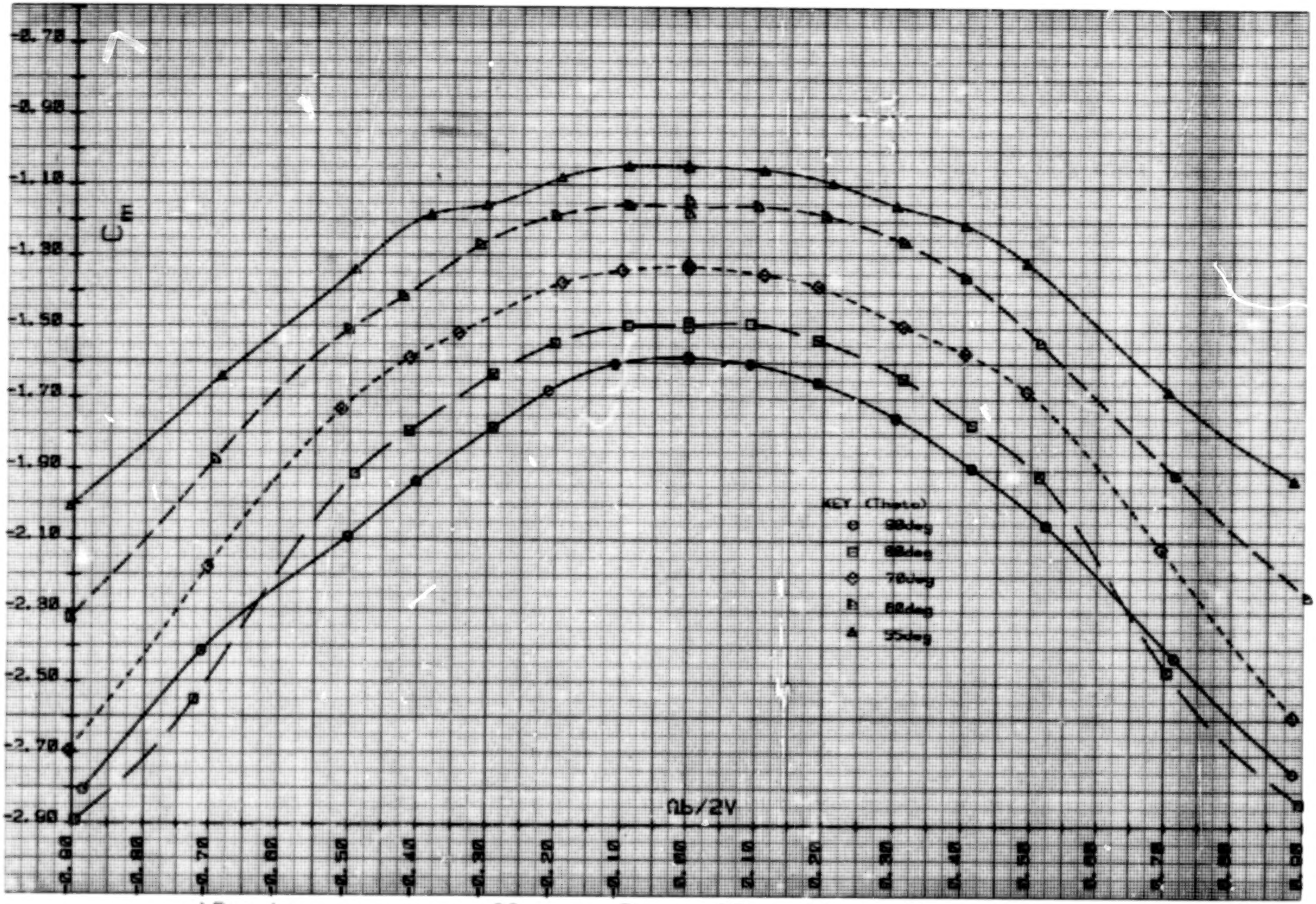
c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 41.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+E.



d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 41.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+E.



e.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 41.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+E.

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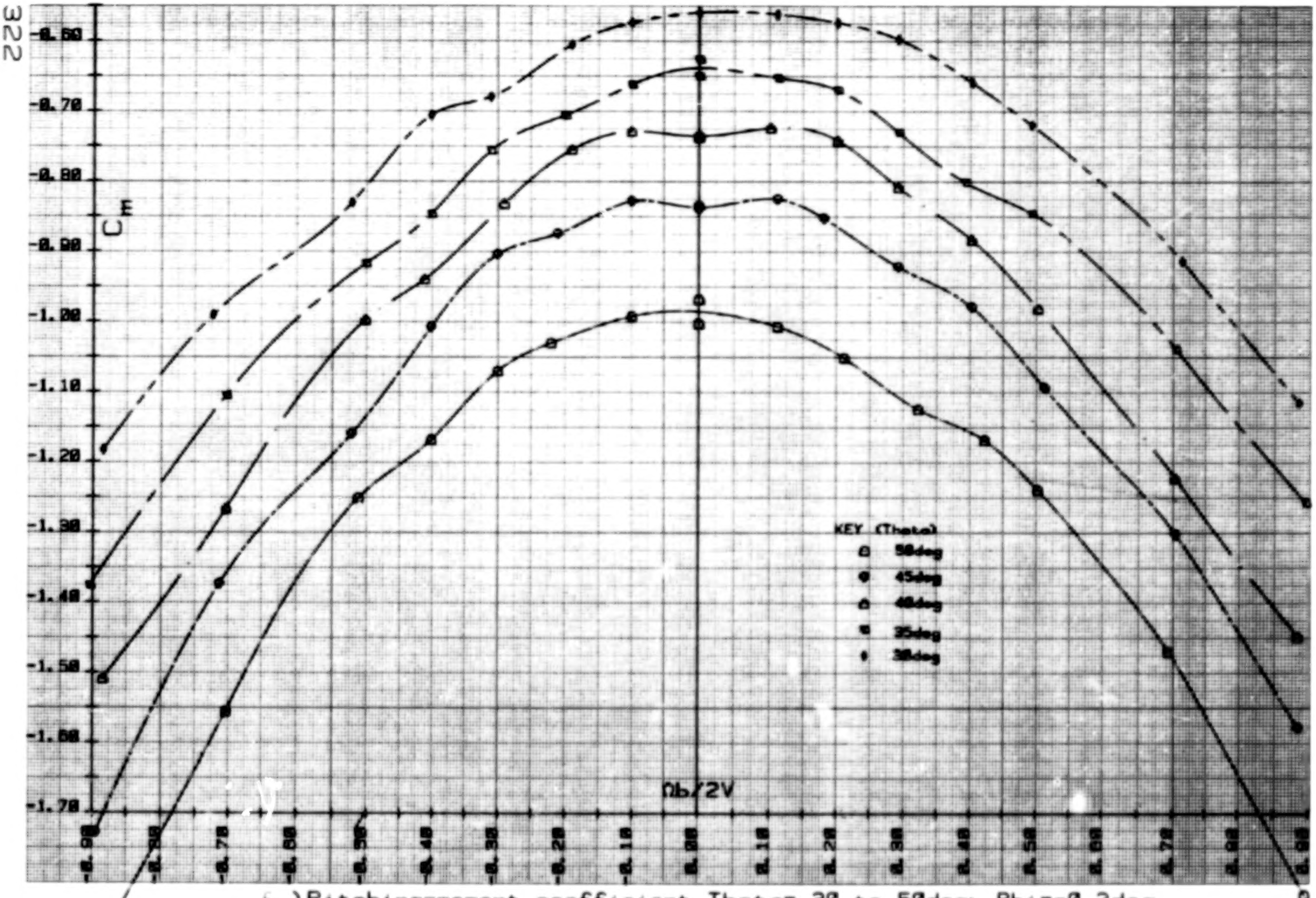
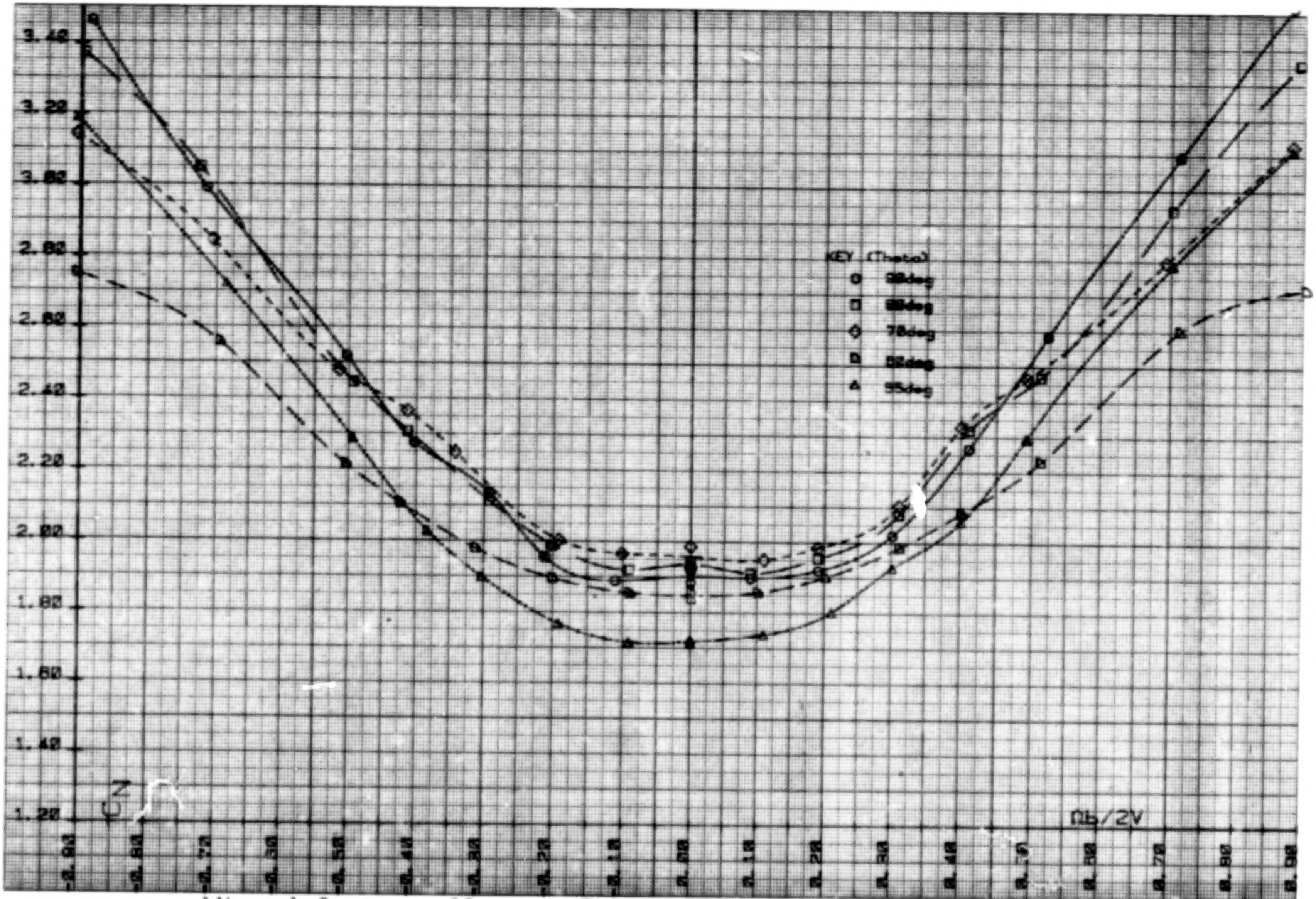


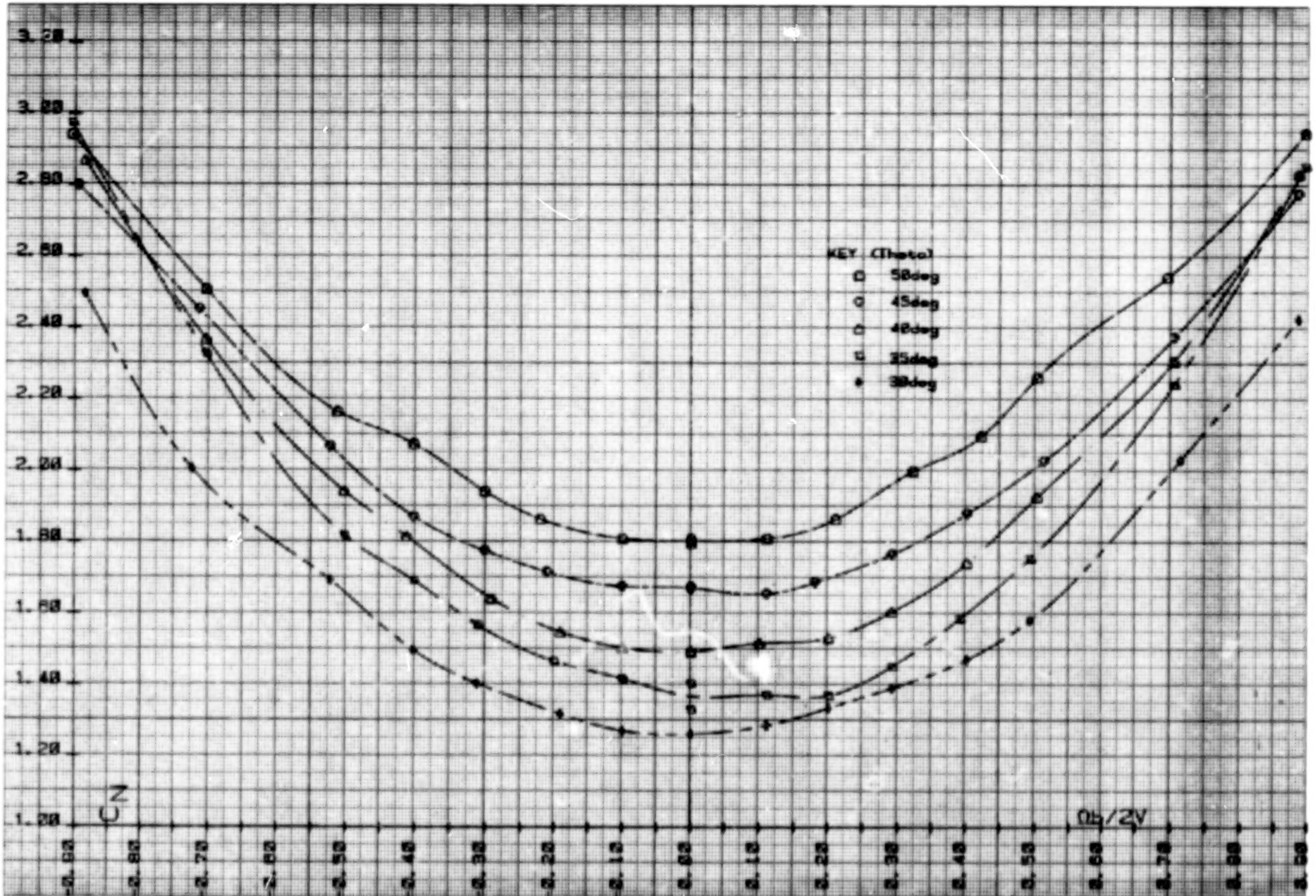
f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 41.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+E.



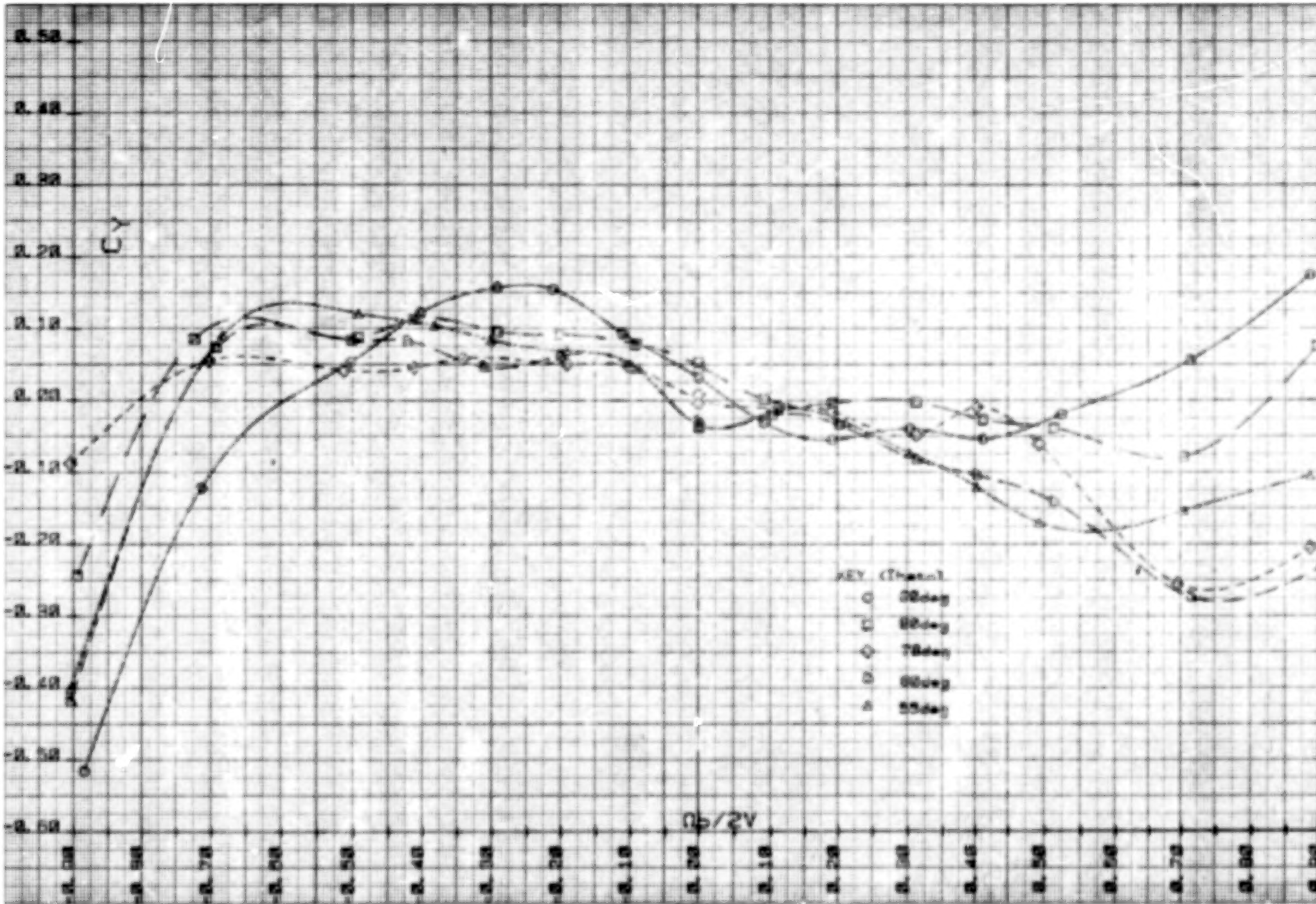
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.2deg.

Figure 41.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+E.



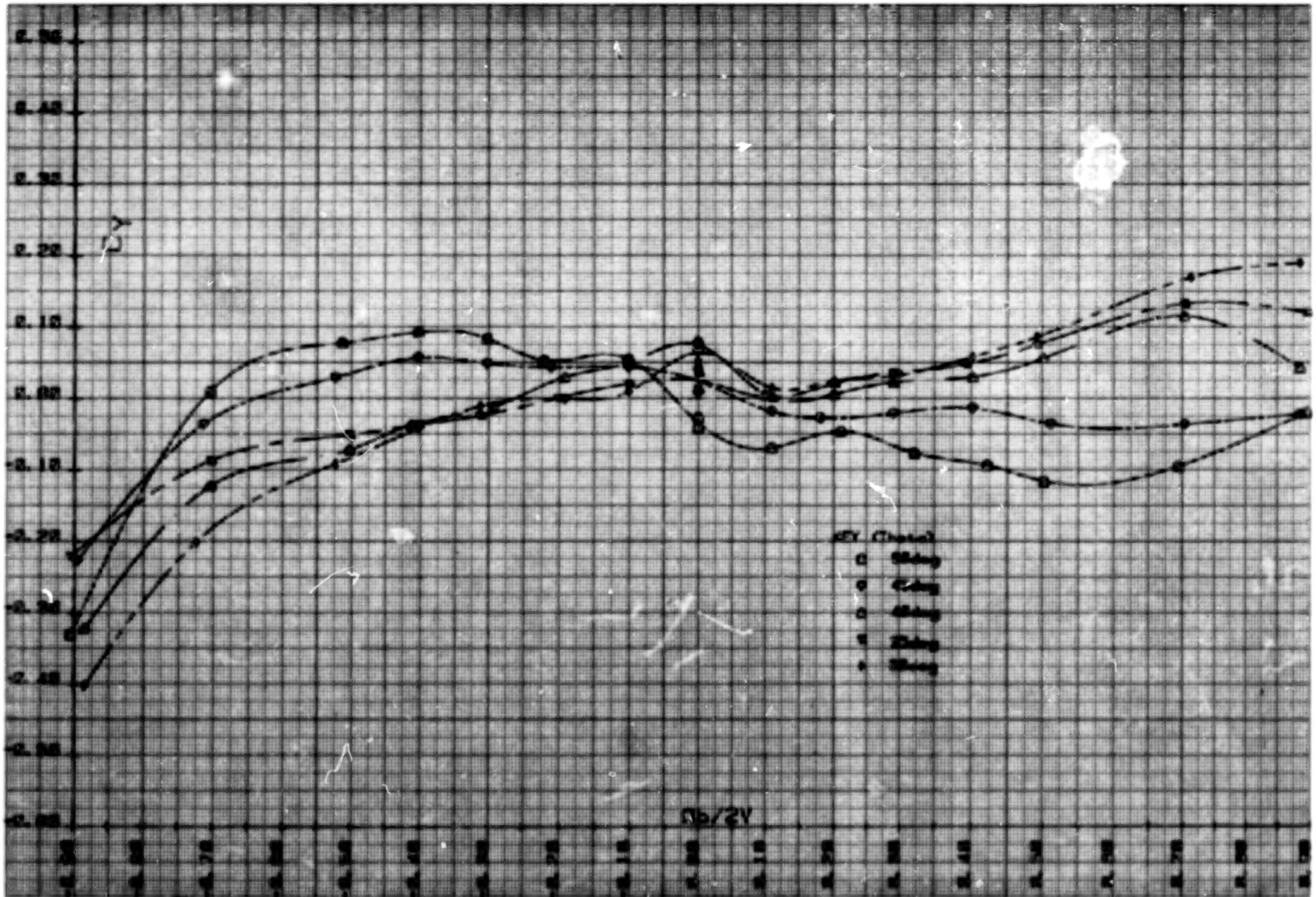
(b.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 41.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+E.



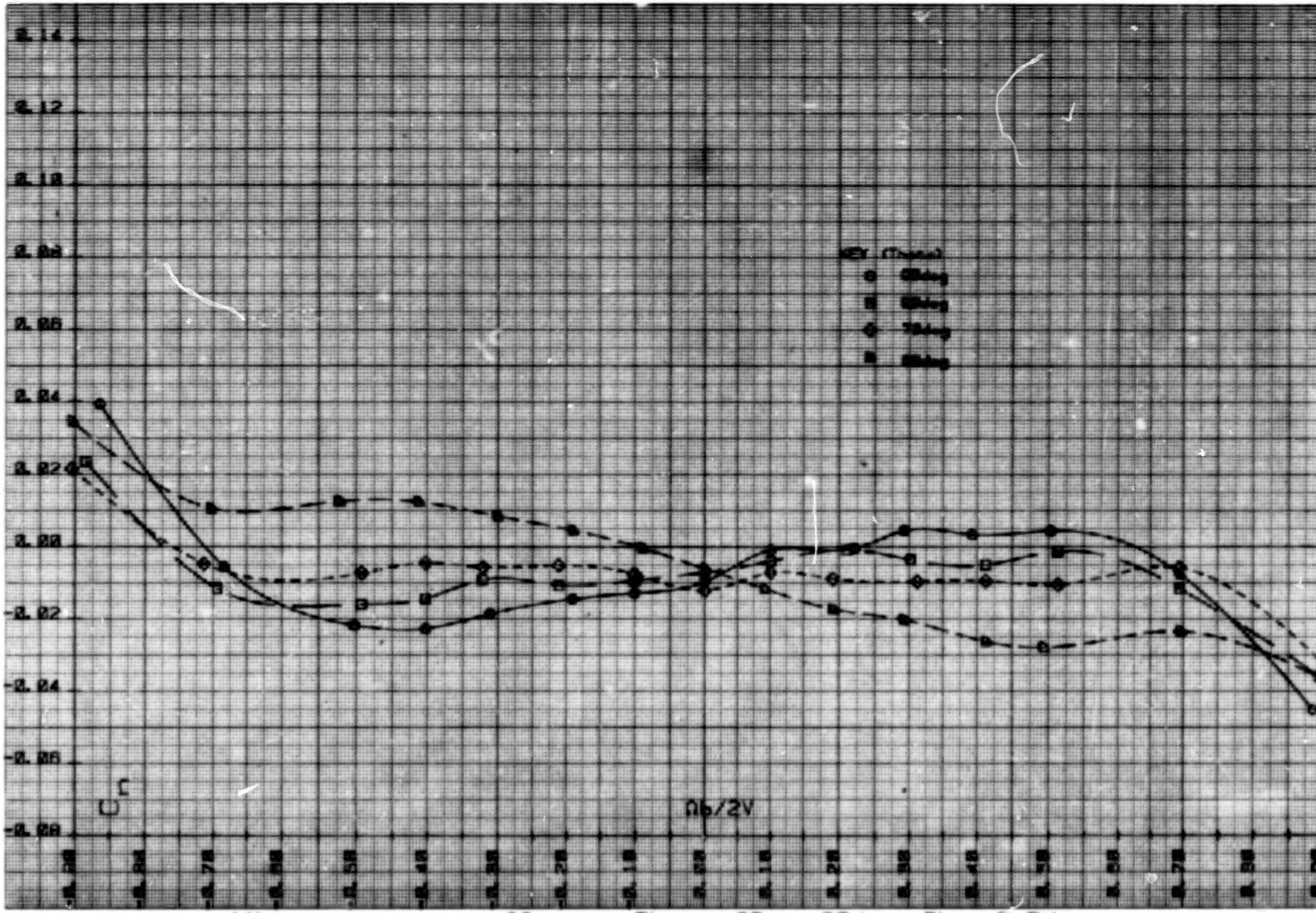
(a) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 41.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+E.



j.) Side-force coefficient. Theta= 30 to 50deg; Phi=-0.2deg.

Figure 41. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+E.



a.) Yawing-moment coefficient, Theta= 60 to 90deg; Phi=-0.5deg.

Figure 42.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp1.

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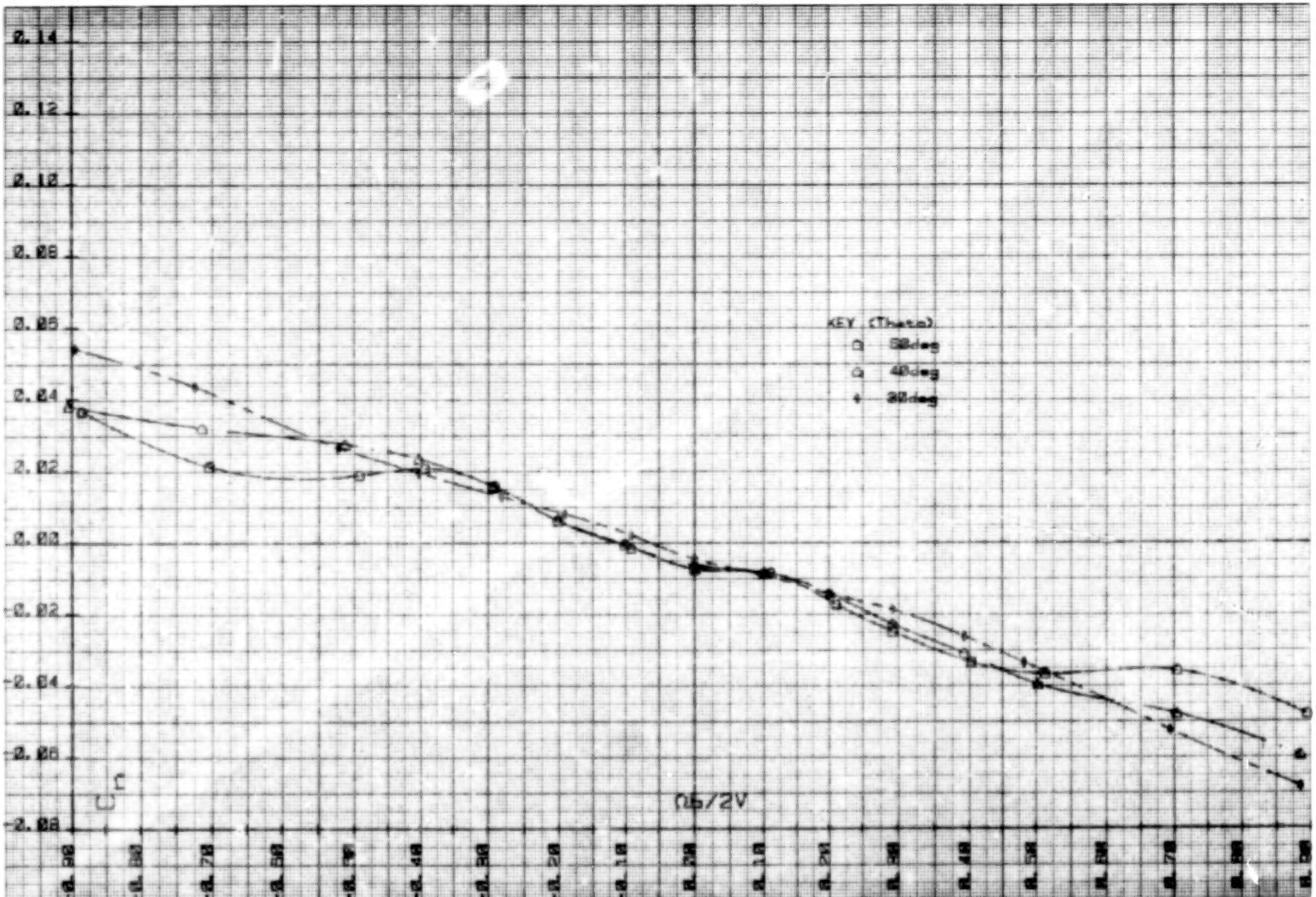
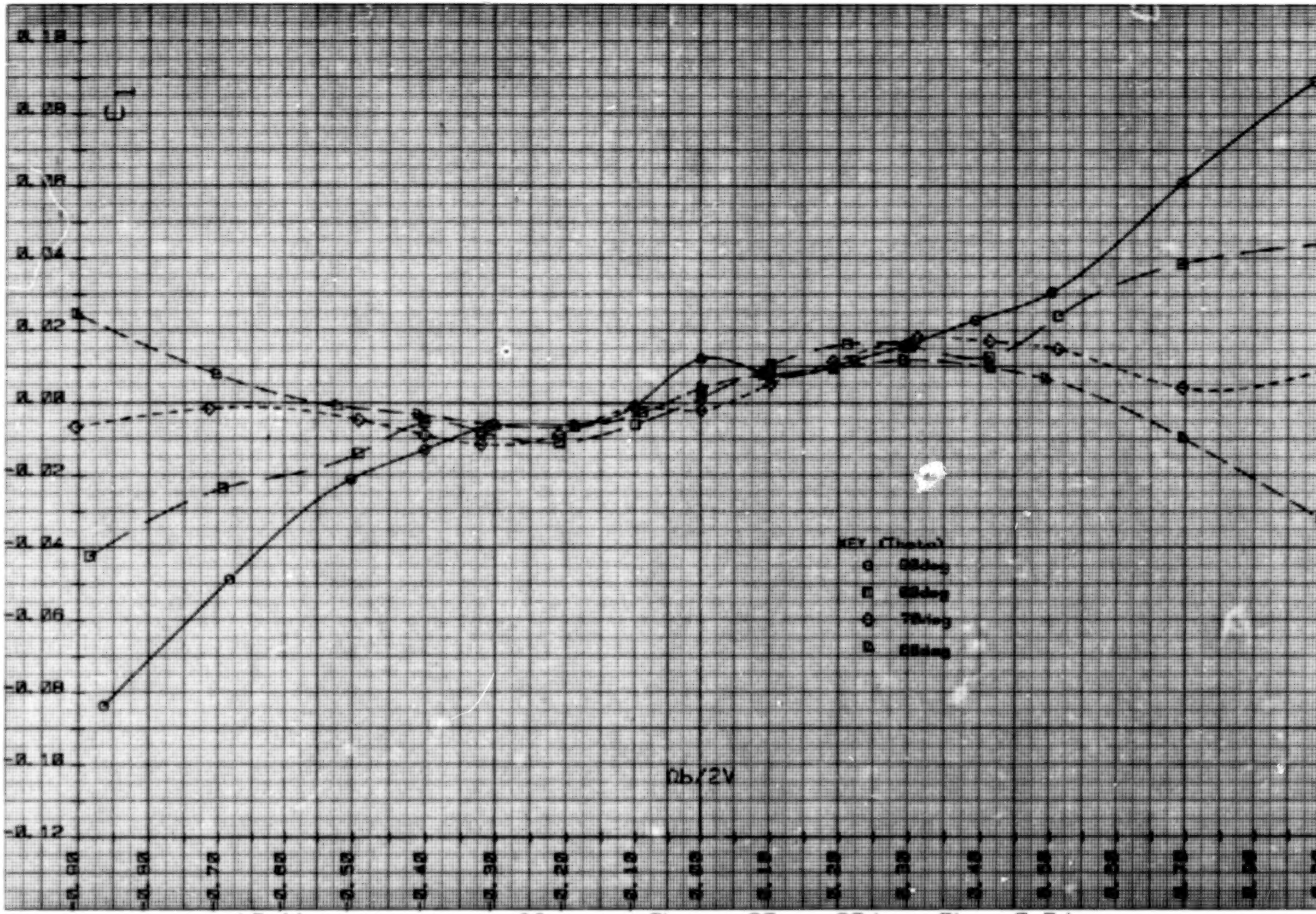


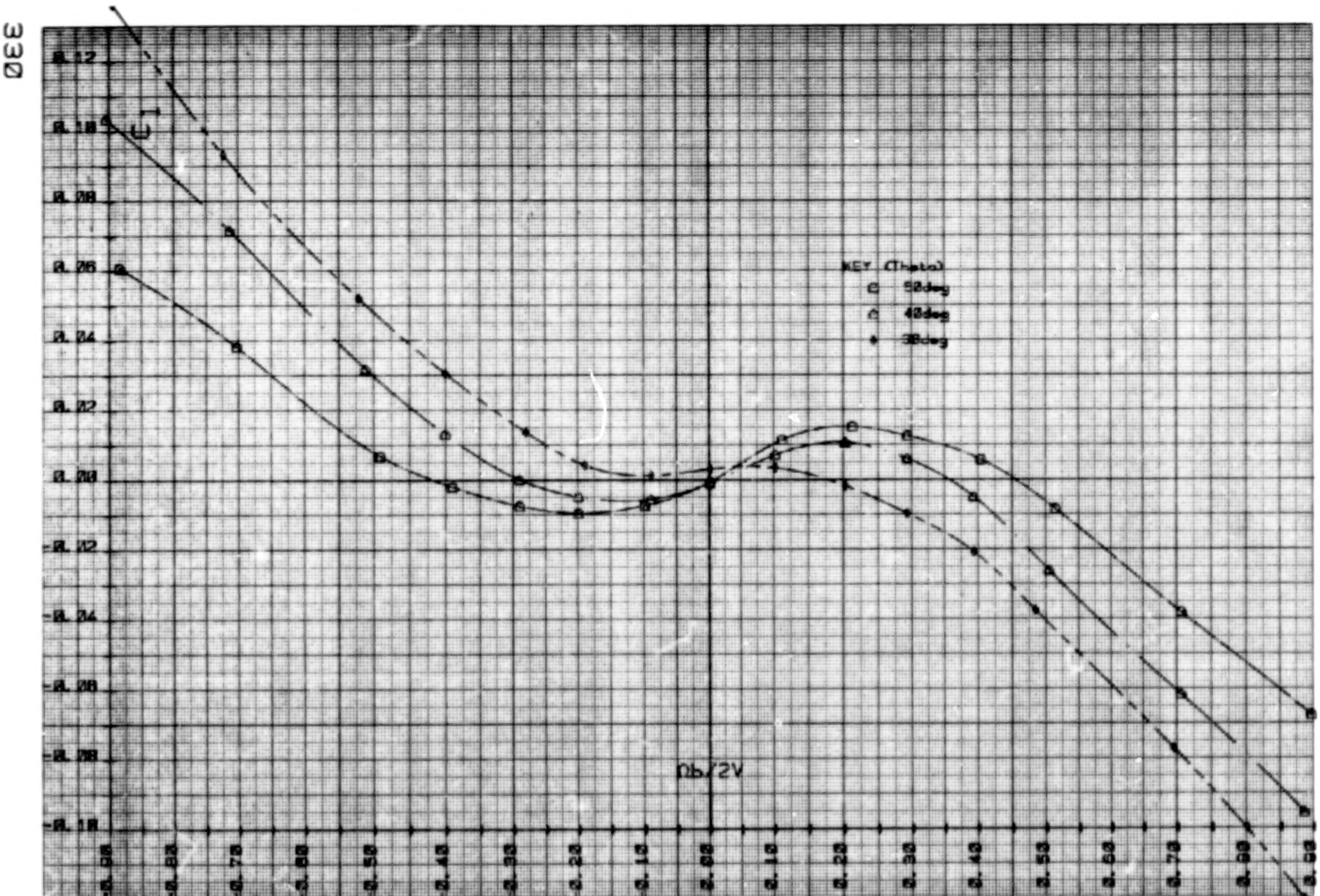
..)Yawing-moment coefficient. Theta= 30 to 50deg; Phi=-0.2deg.

Figure 42.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp1.



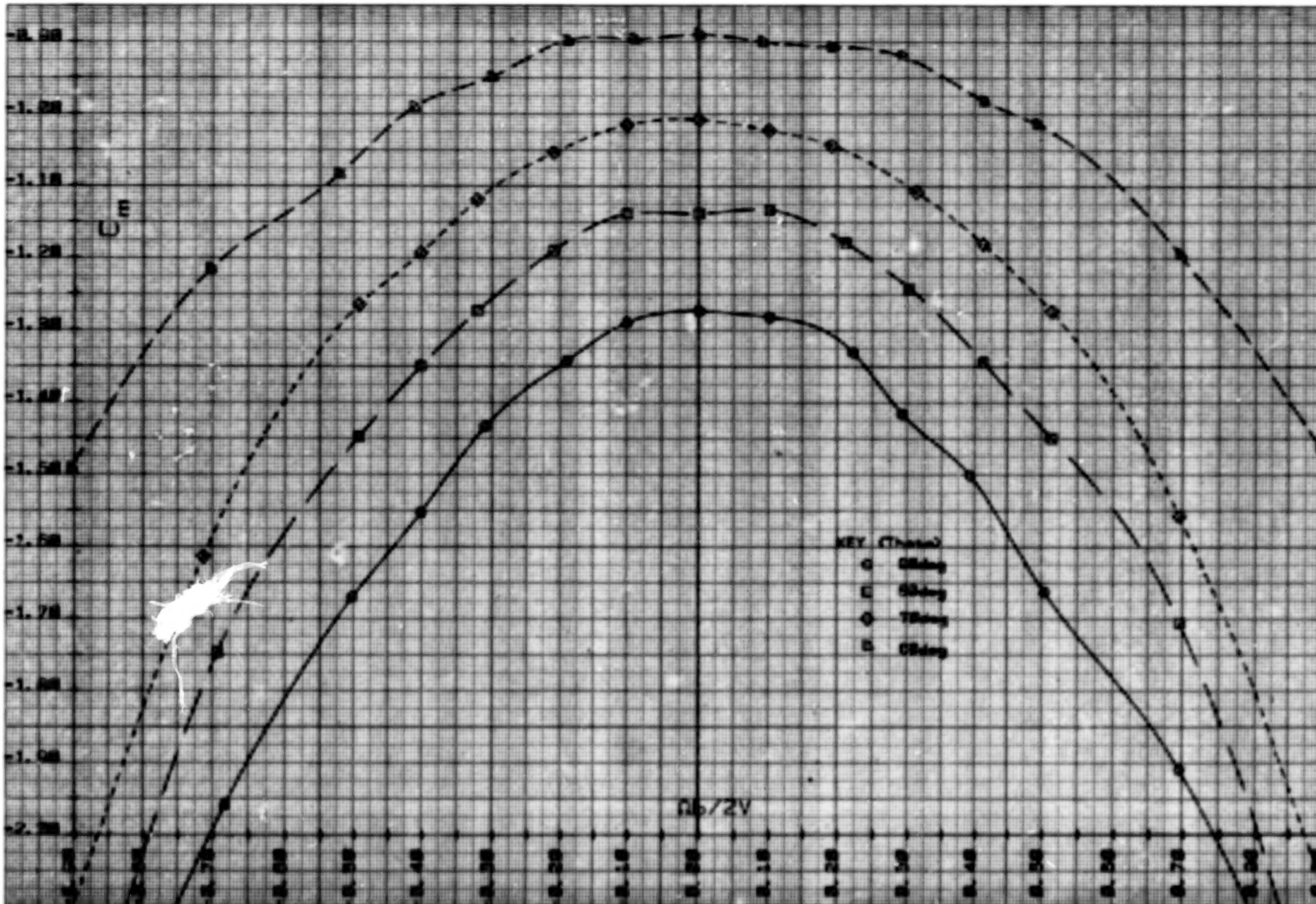
c.) Rolling-moment coefficient, Theta= 60 to 90deg; Phi=-0.5deg.

Figure 42.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp1.



d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 42.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp1.



e.)Pitching-moment coefficient, Theta= 60 to 90deg; Phi=-0.2deg.

Figure 42.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp1.

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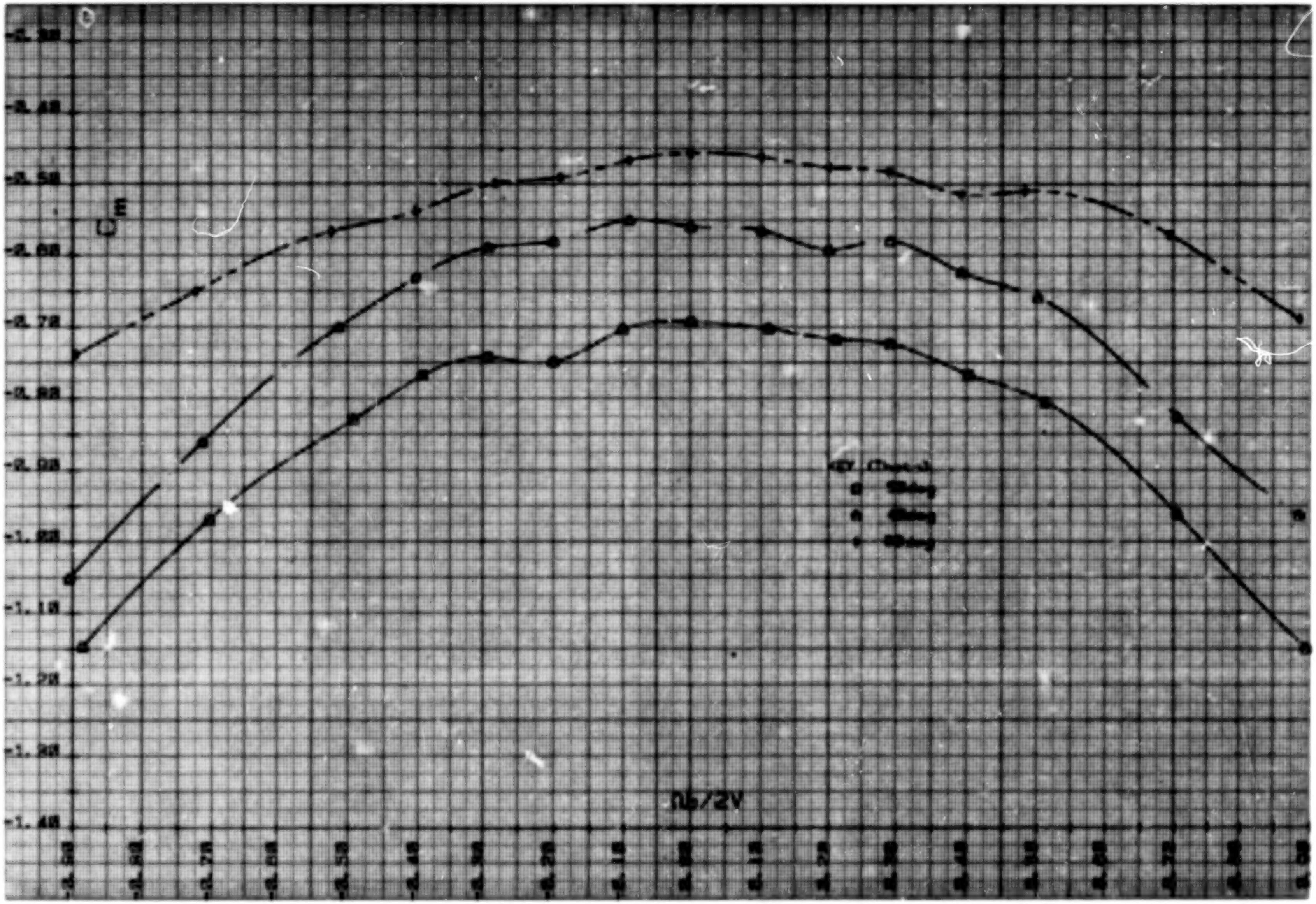
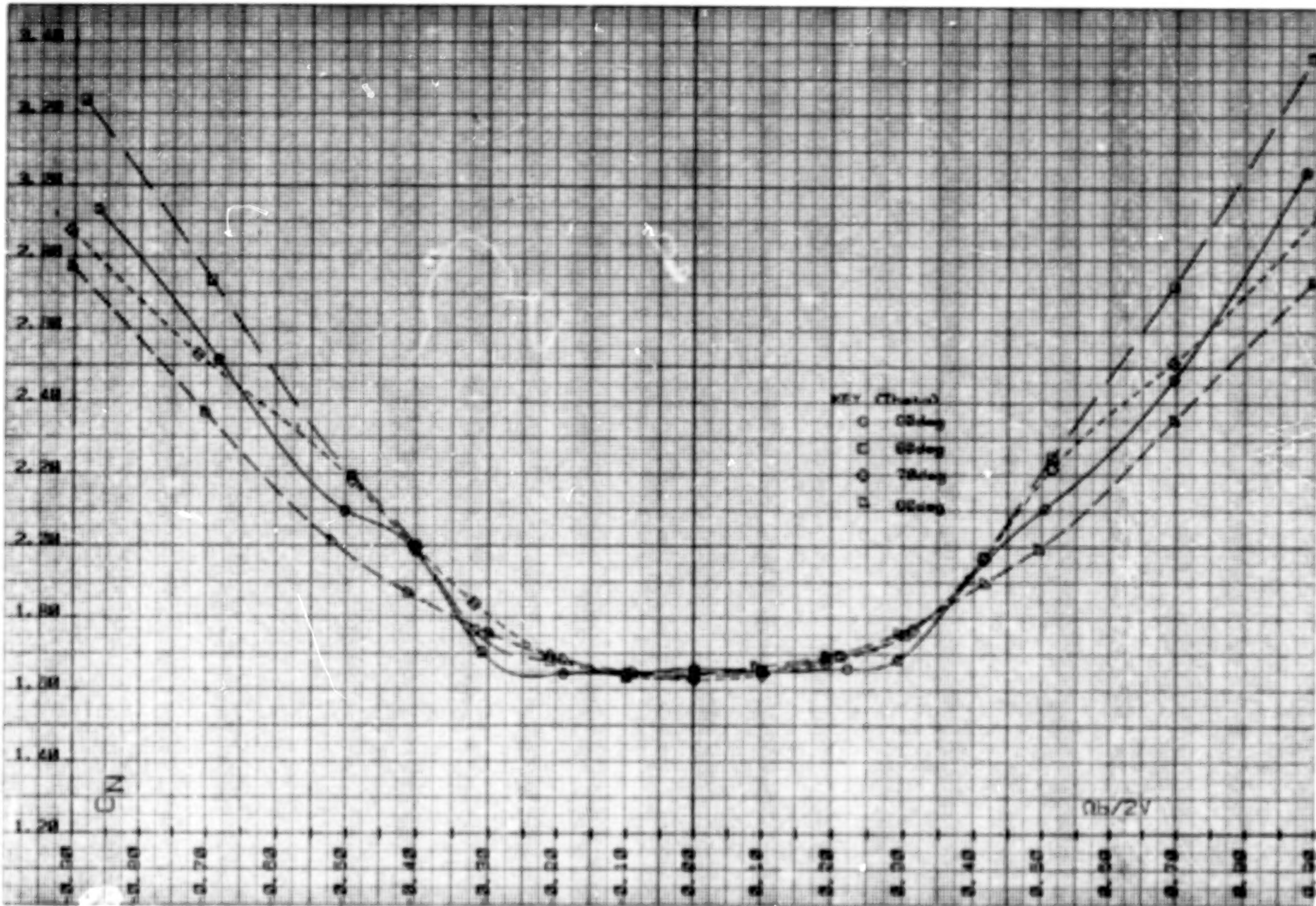


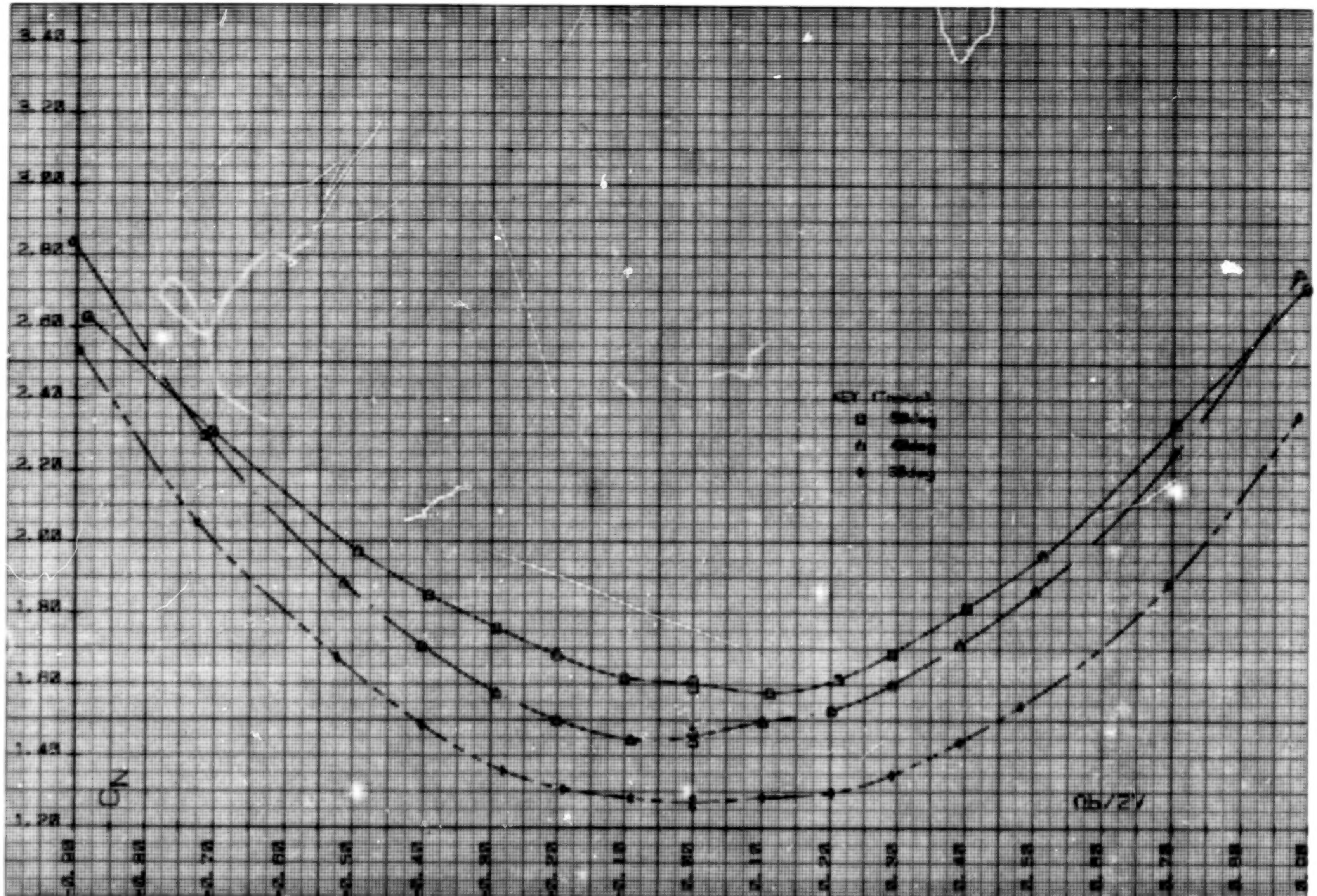
f.)Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 42.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp1.



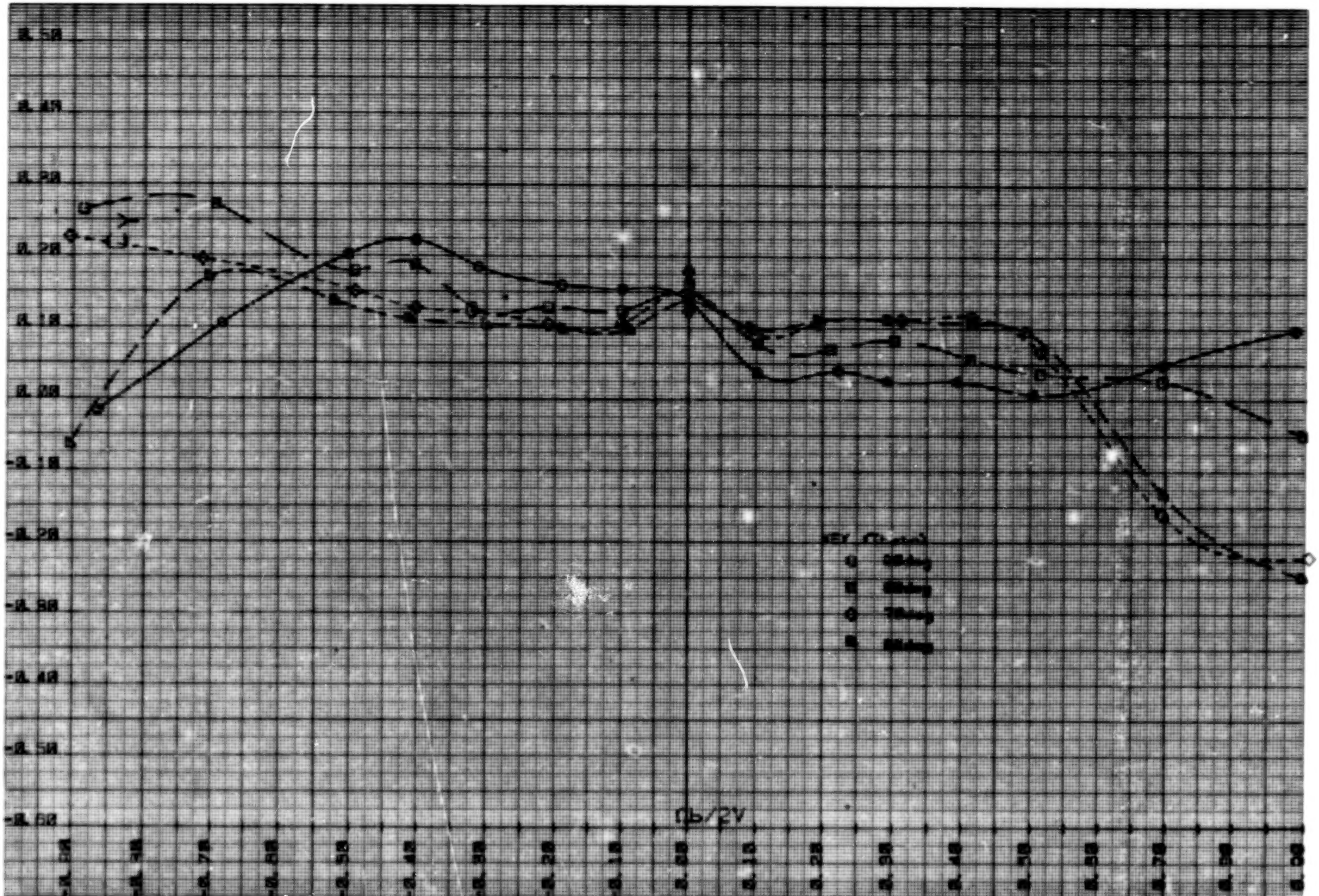
g.) Normal-force coefficient, Theta= 60 to 90deg; Phi=-0.2deg.

Figure 42. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp1.



h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 42.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp1.



(i) Side-force coefficient, Theta= 60 to 90deg; Phi=-0.2deg.

Figure 42. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp1.

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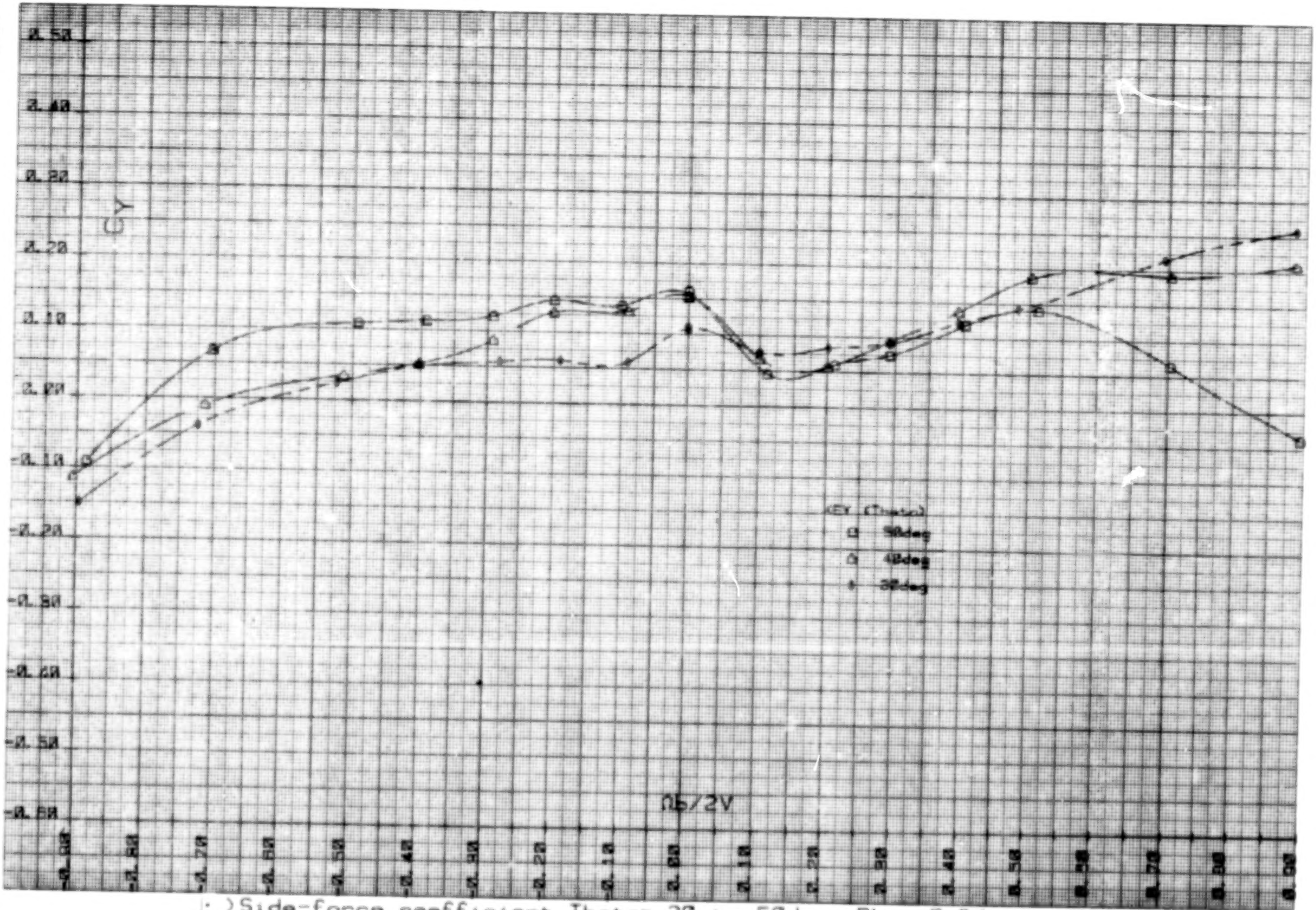
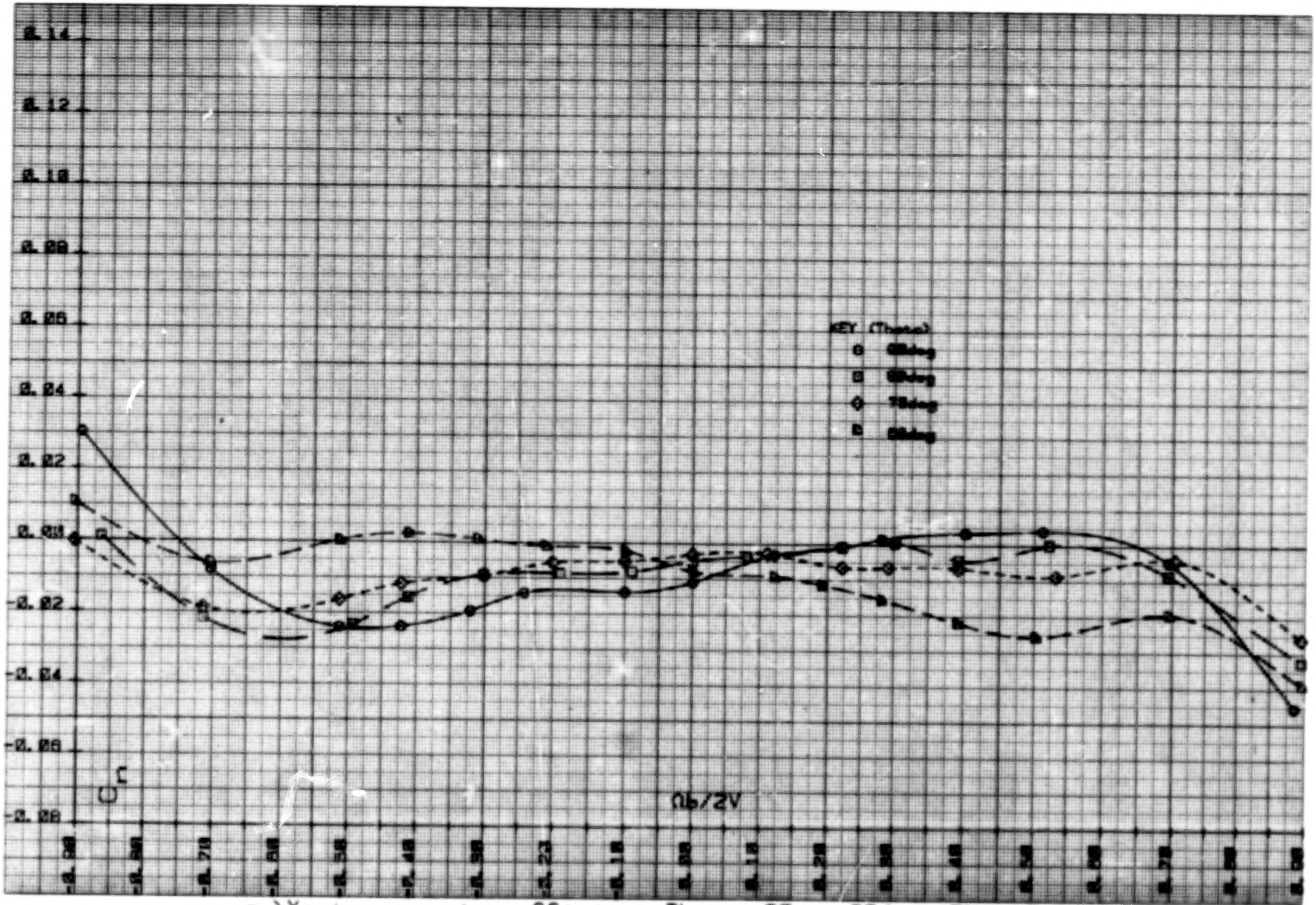


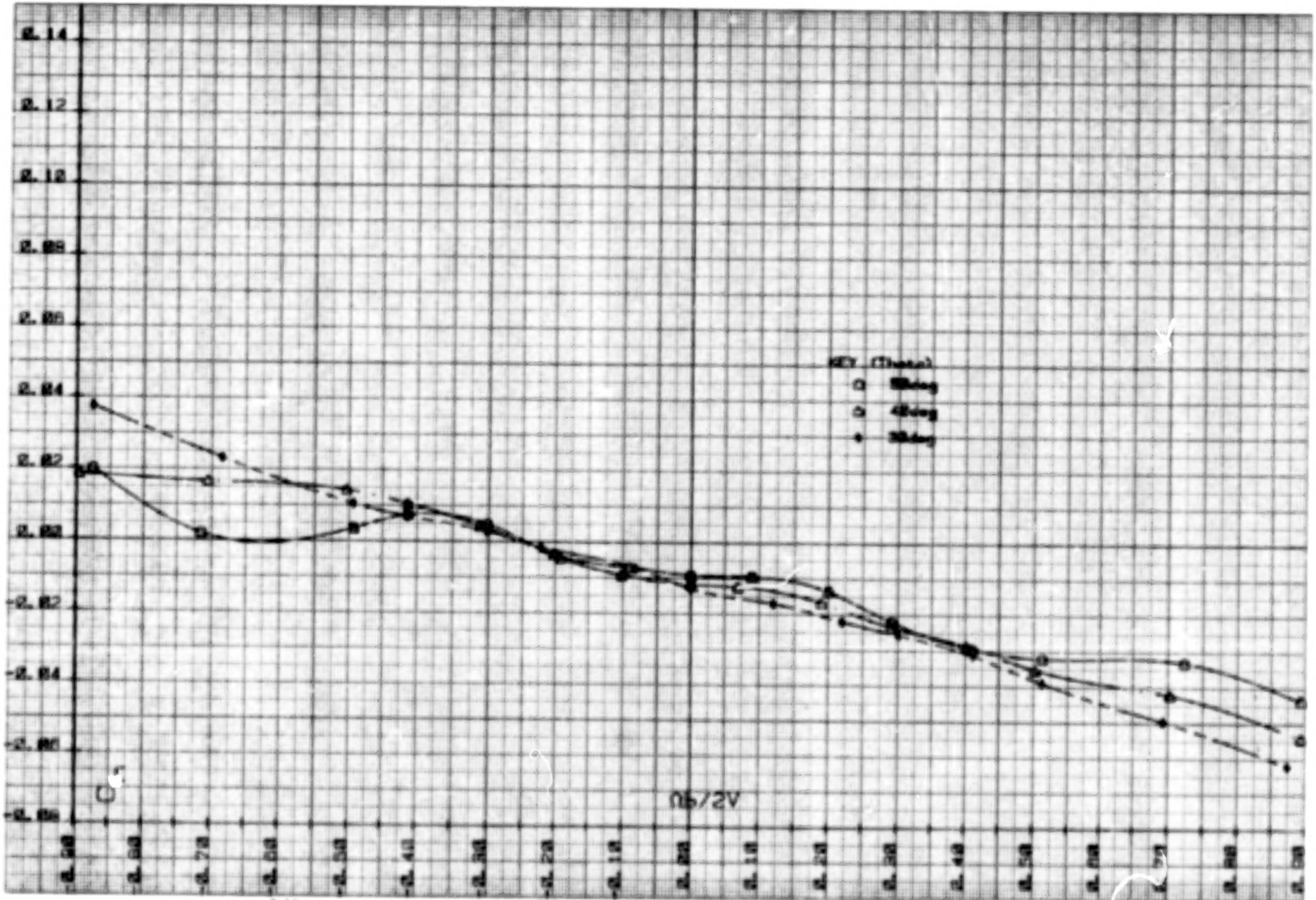
( ) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 42.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp1.



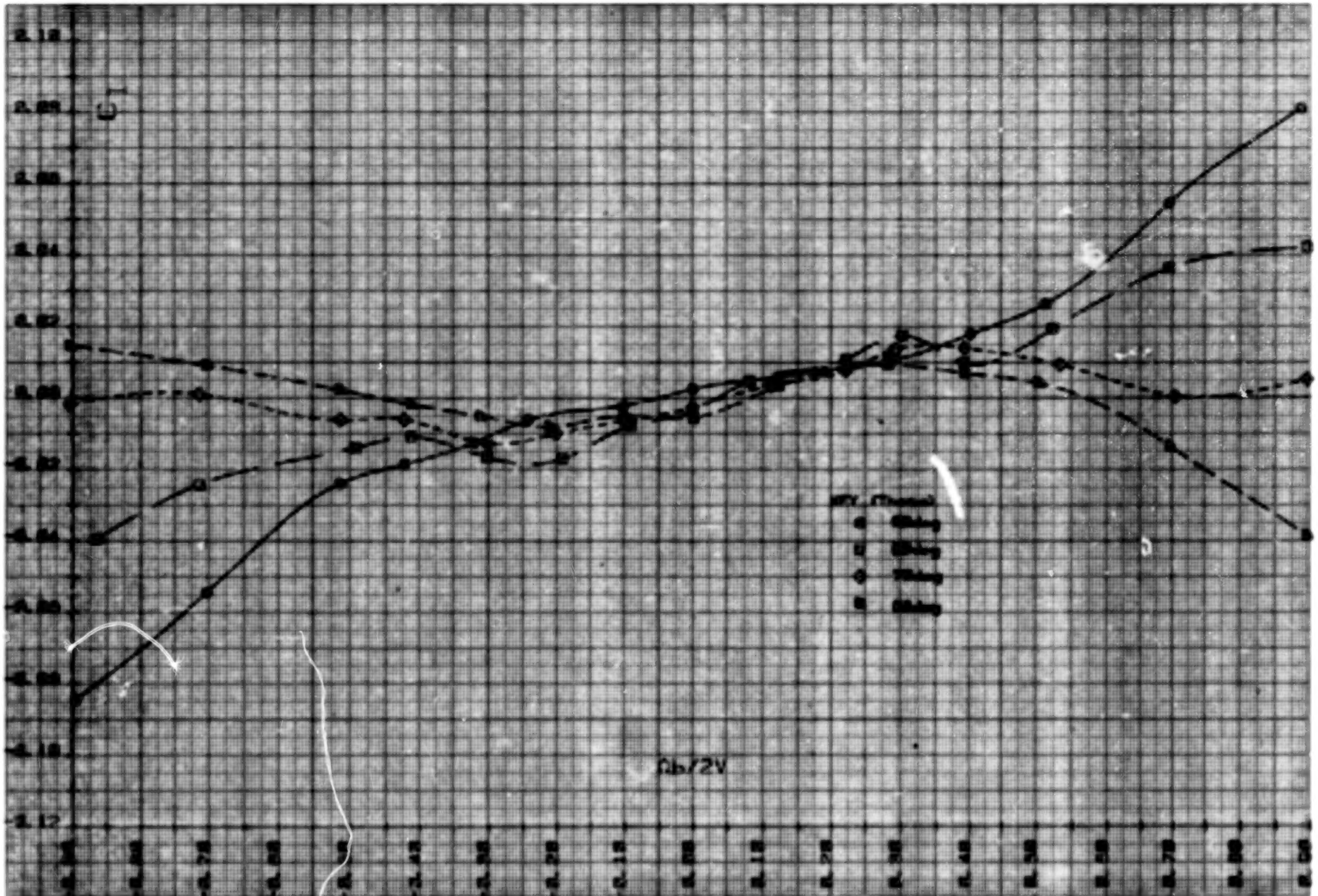
a.) Yawing-moment coefficient, Theta= 60 to 90deg; Phi=-0.8deg.

Figure 43.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+1/2Sp1.



(h.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 43.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+1/2Sp1.



c.) Rolling-moment coefficient, Theta= 60 to 90deg; Phi=-0.8deg.

Figure 43.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+1/2Sp1.

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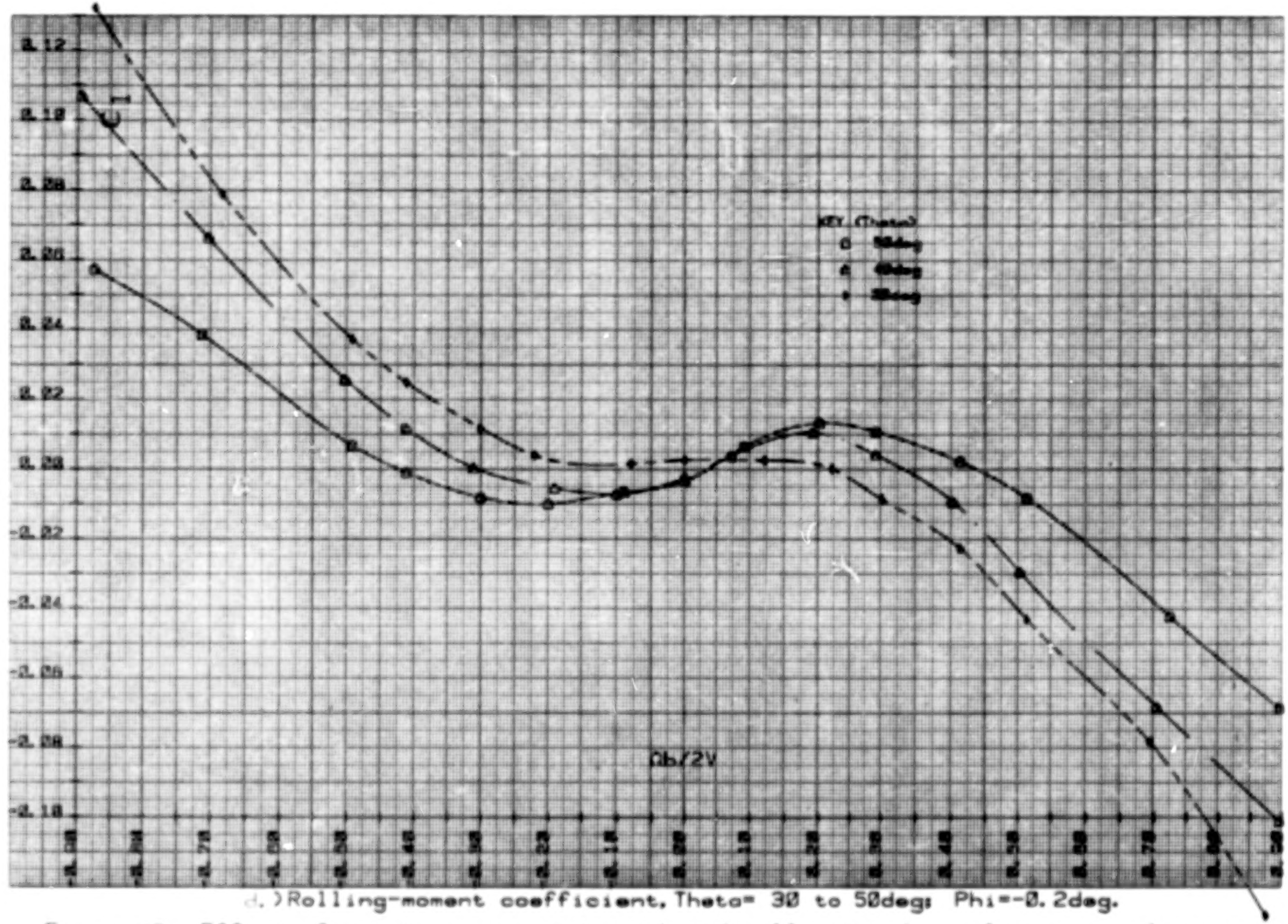
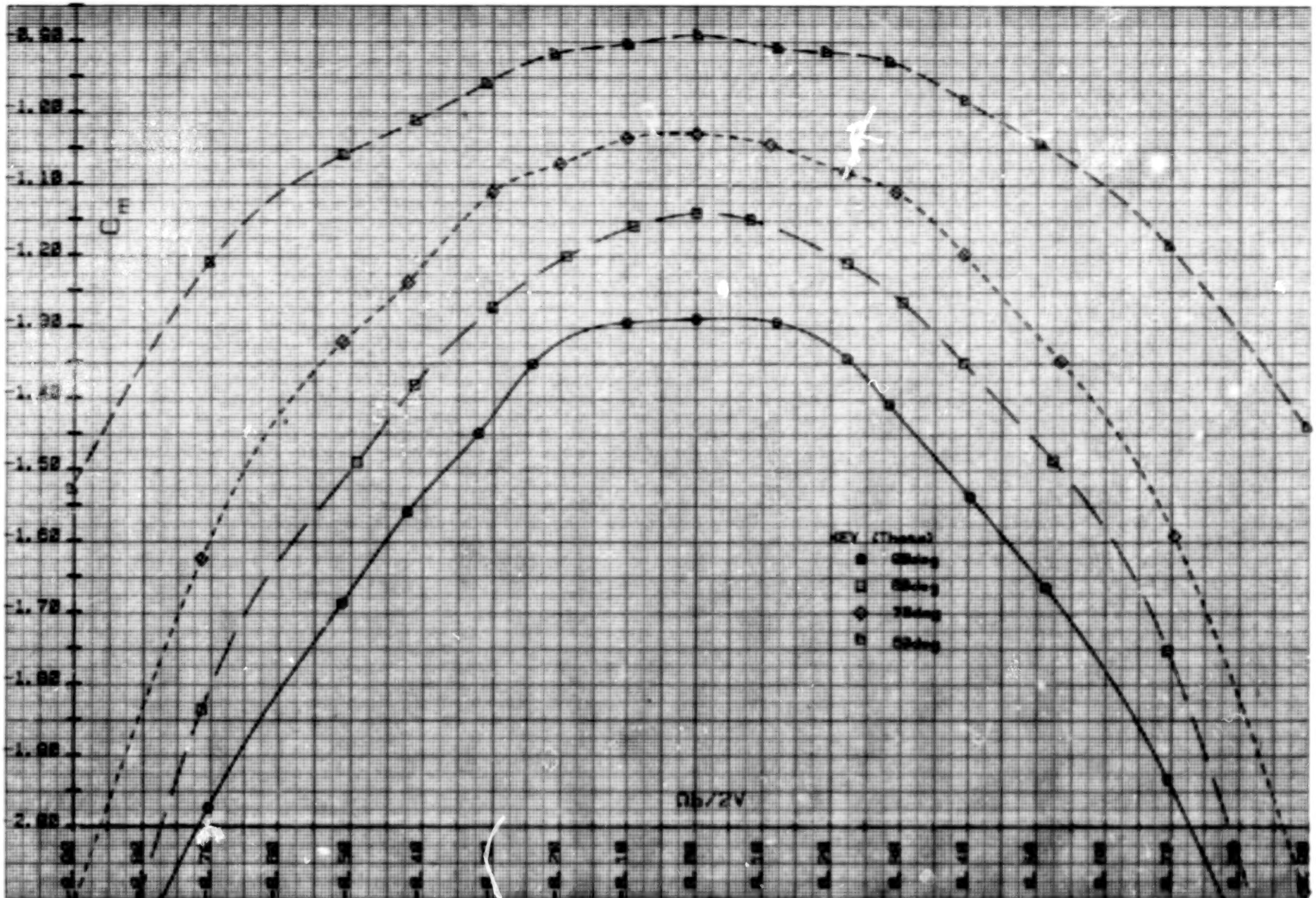


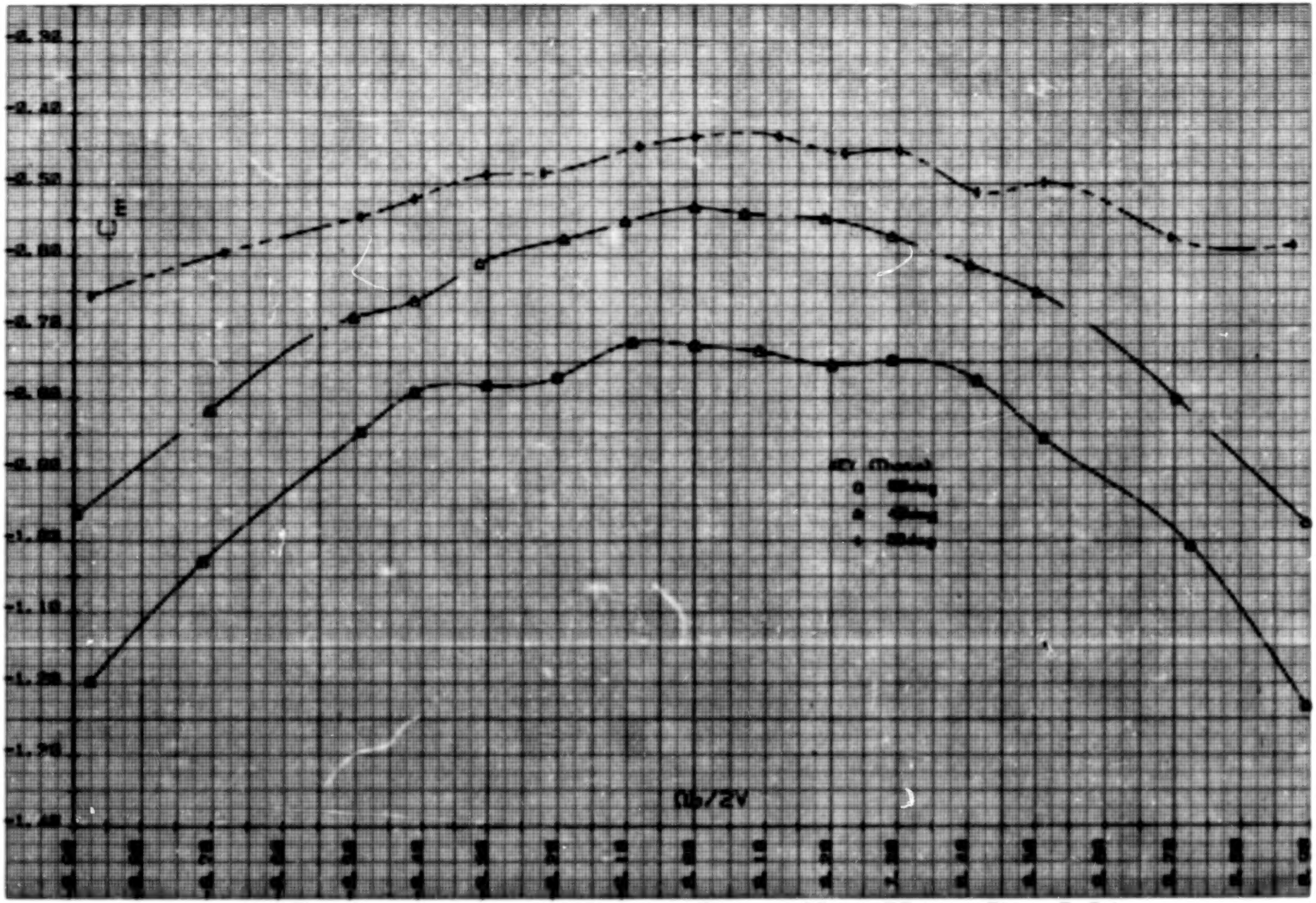
d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 43.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+1/2Sp1.



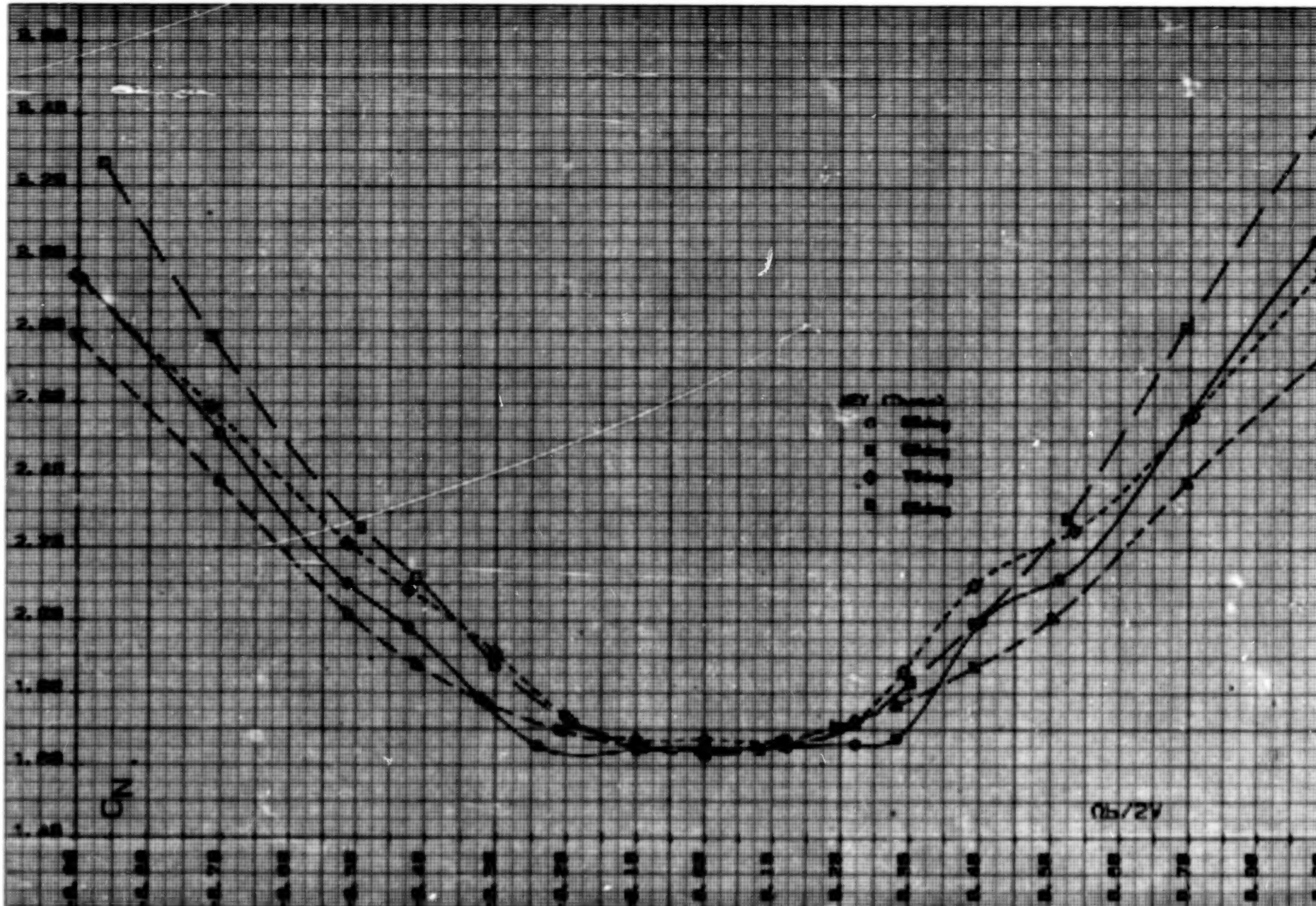
e.)Pitching-moment coefficient, Theta= 60 to 90deg: Phi=-0.2deg.

Figure 43.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+1/2Sp1.



f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 43. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+1/2Sp1.



g.) Normal-force coefficient, Theta= 60 to 90deg; Phi=-0.2deg.

Figure 43. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+1/2Sp1.

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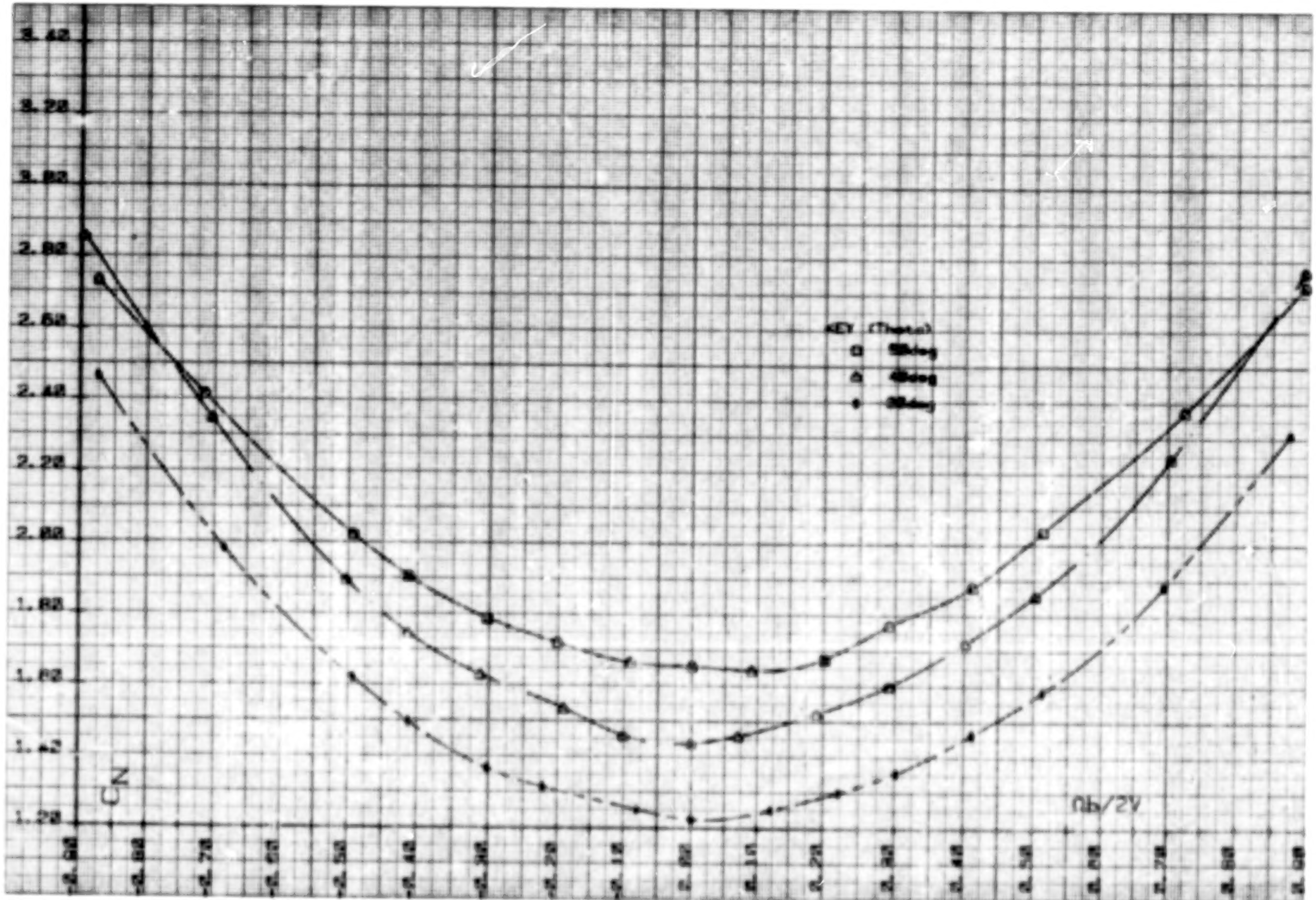
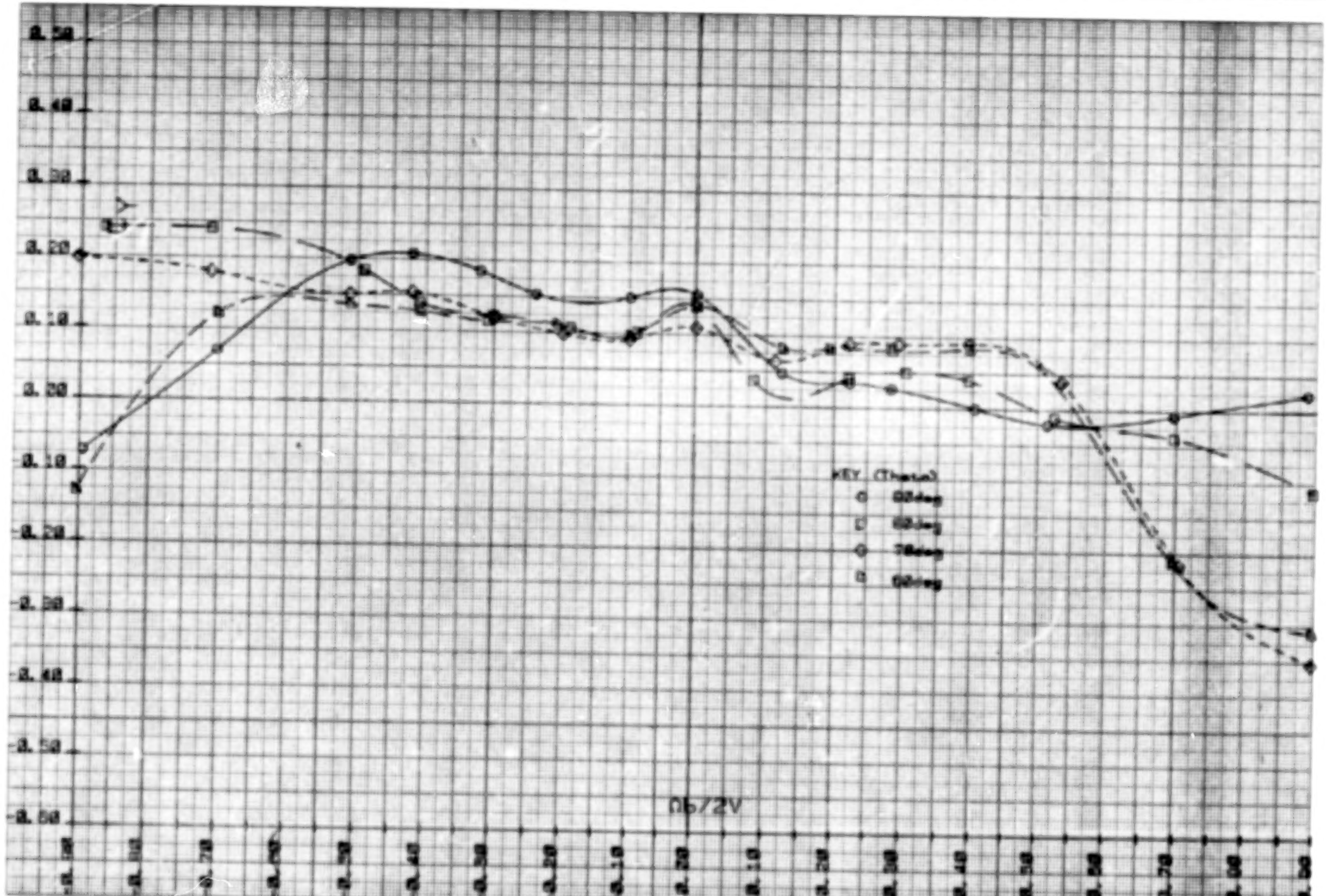


)Normal-force coefficient, Theta= 3Ø to 5Ødeg; Phi=-Ø.2deg.

Figure 43.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+1/2Sp1.



(. .)Side-force coefficient, Theta= 60 to 90deg; Phi=-0.8deg.

Figure 43 .-Effect of rotation rate and pitch and roll attit de angles on aerodynamic characteristics for configuration BW1H4V+1/2Sp1.

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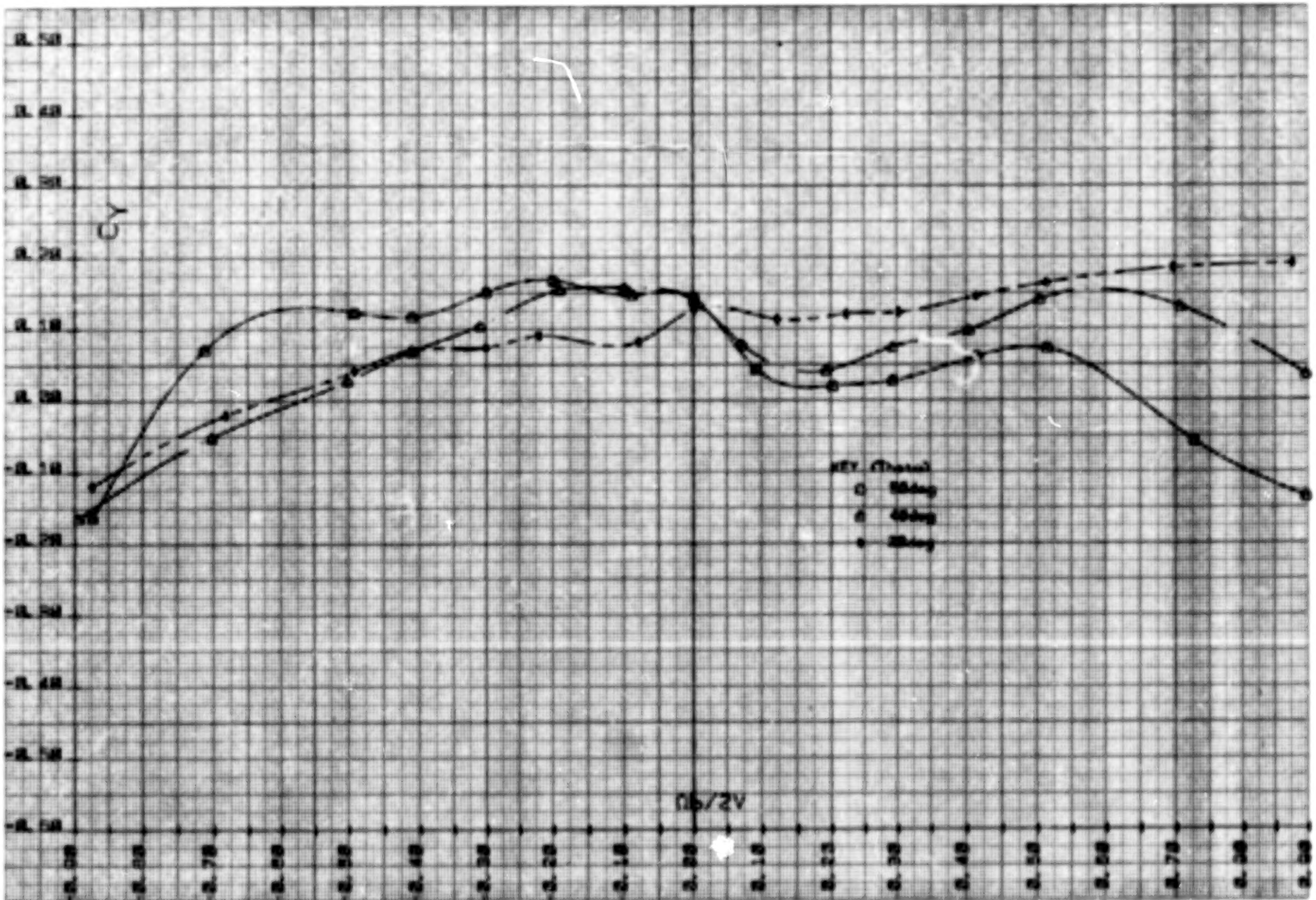
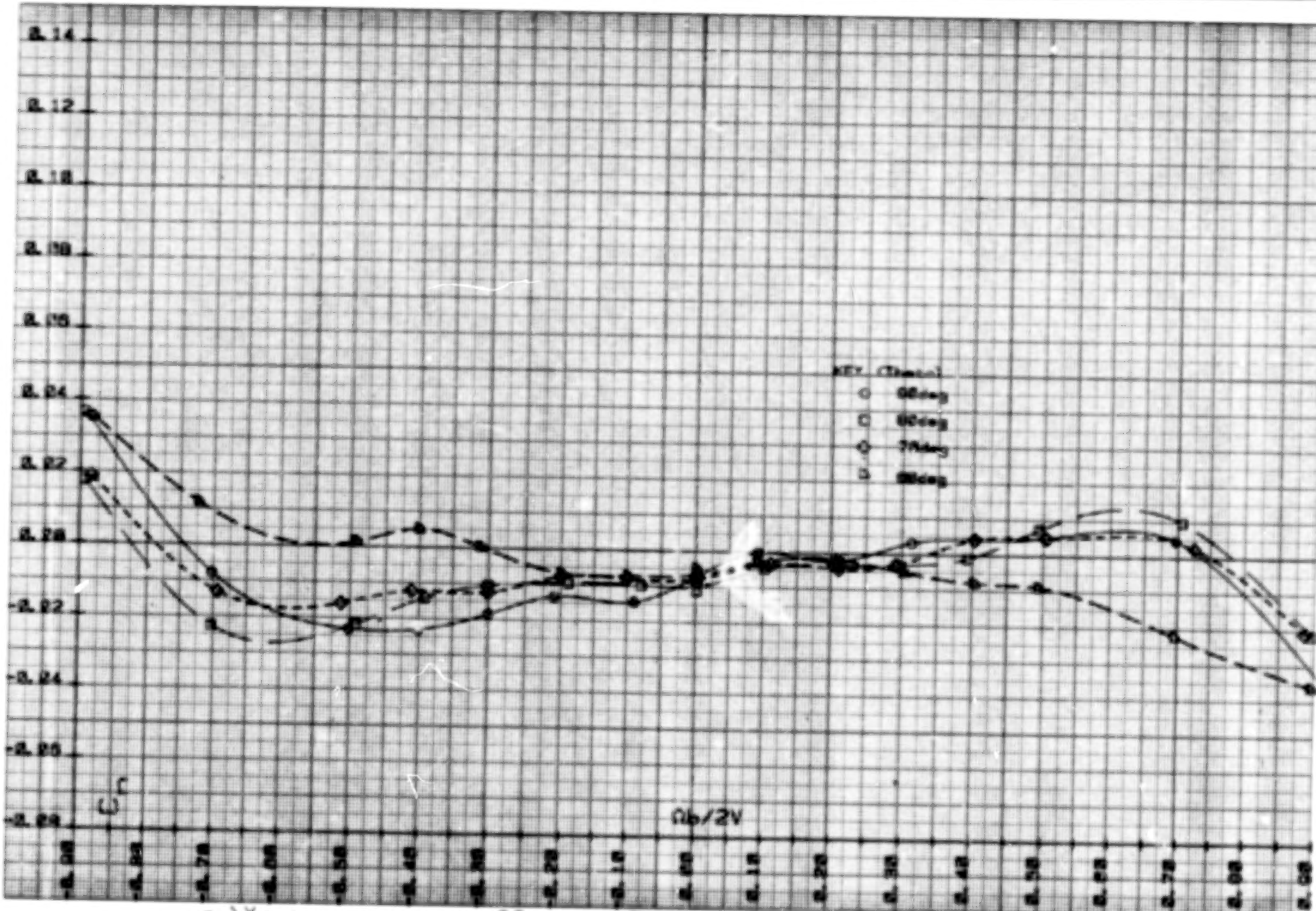


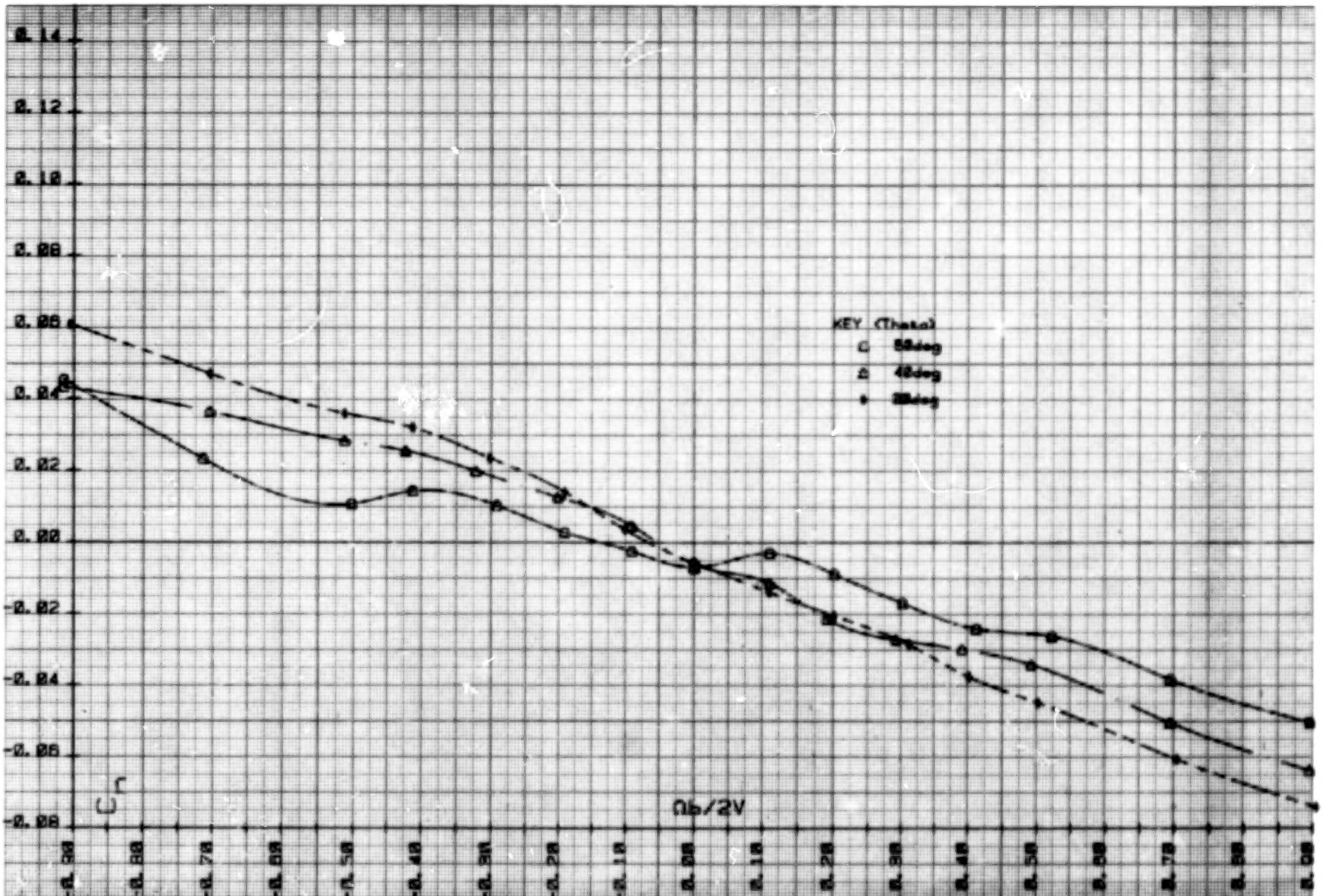
)Side-force coefficient, Theta= 30 to 50deg; Phi=-0.2deg.

Figure 43. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+1/2Sp1.



a.) Yawing-moment coefficient, Theta= 60 to 90deg; Phi=-0.1deg.

Figure 44.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp2.



b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi= 0.3deg.

Figure 44.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp2.

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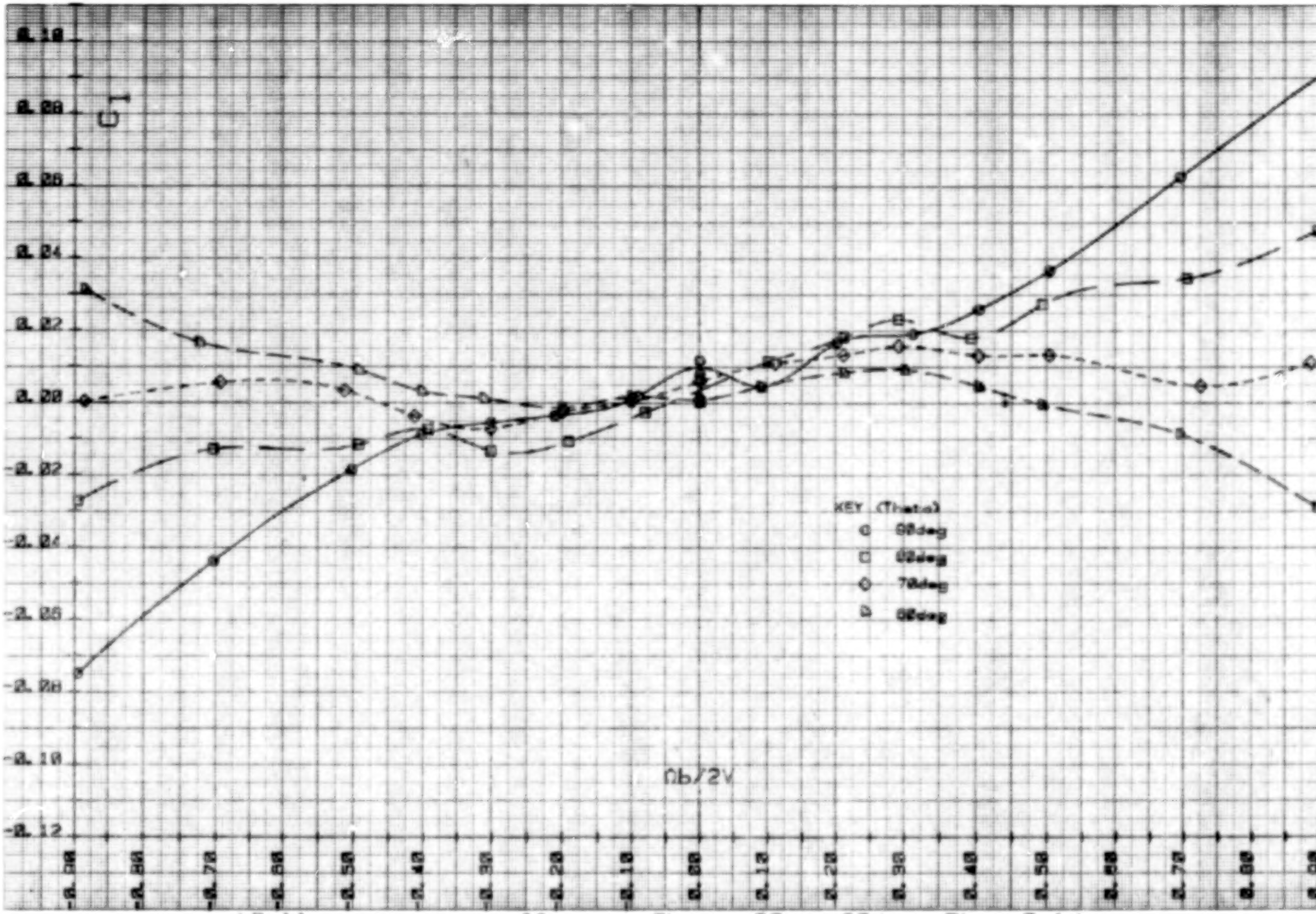

c.)Rolling-moment coefficient, Theta= 60 to 90deg; Phi=-0.1deg.

Figure 44.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp2.

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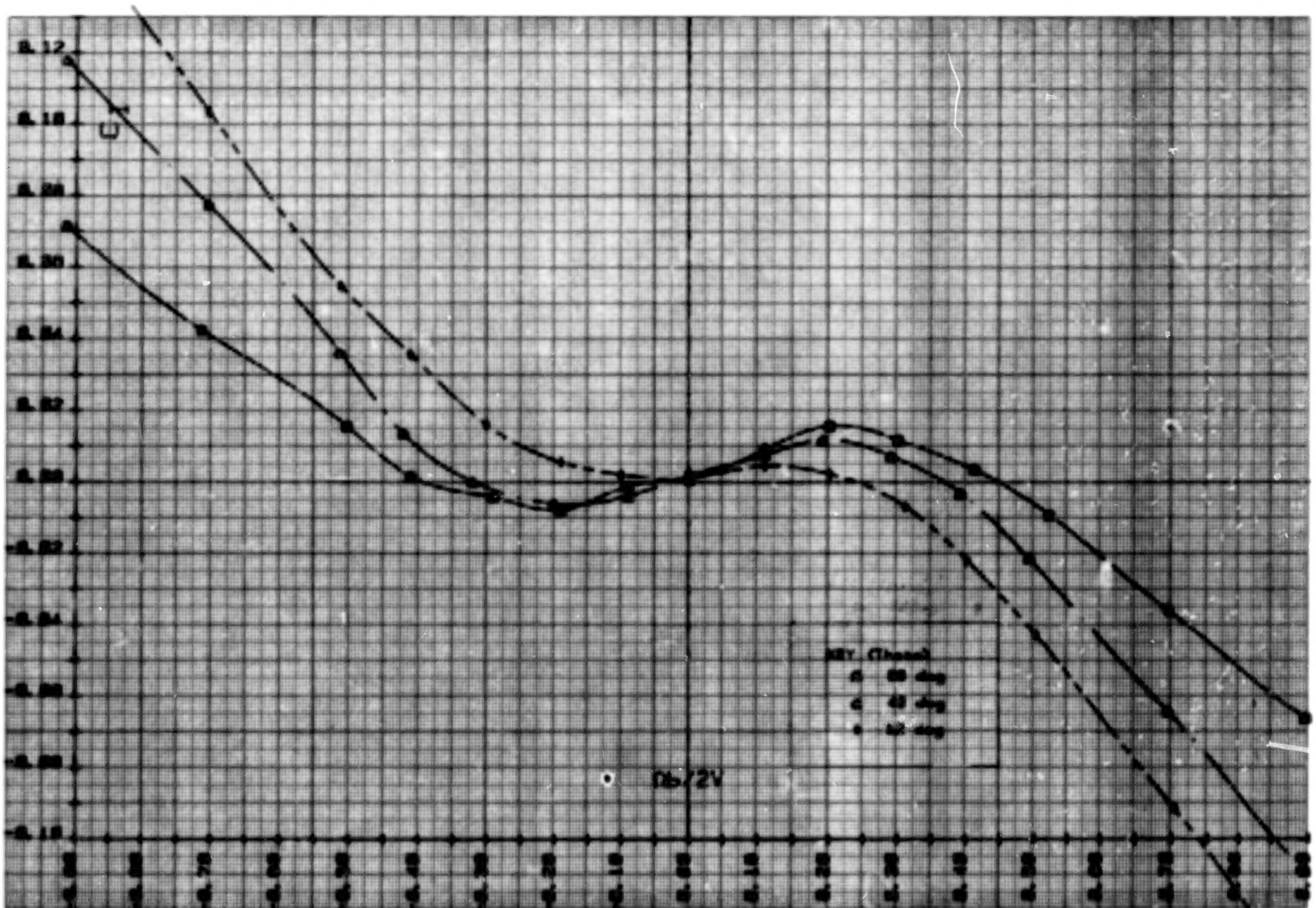
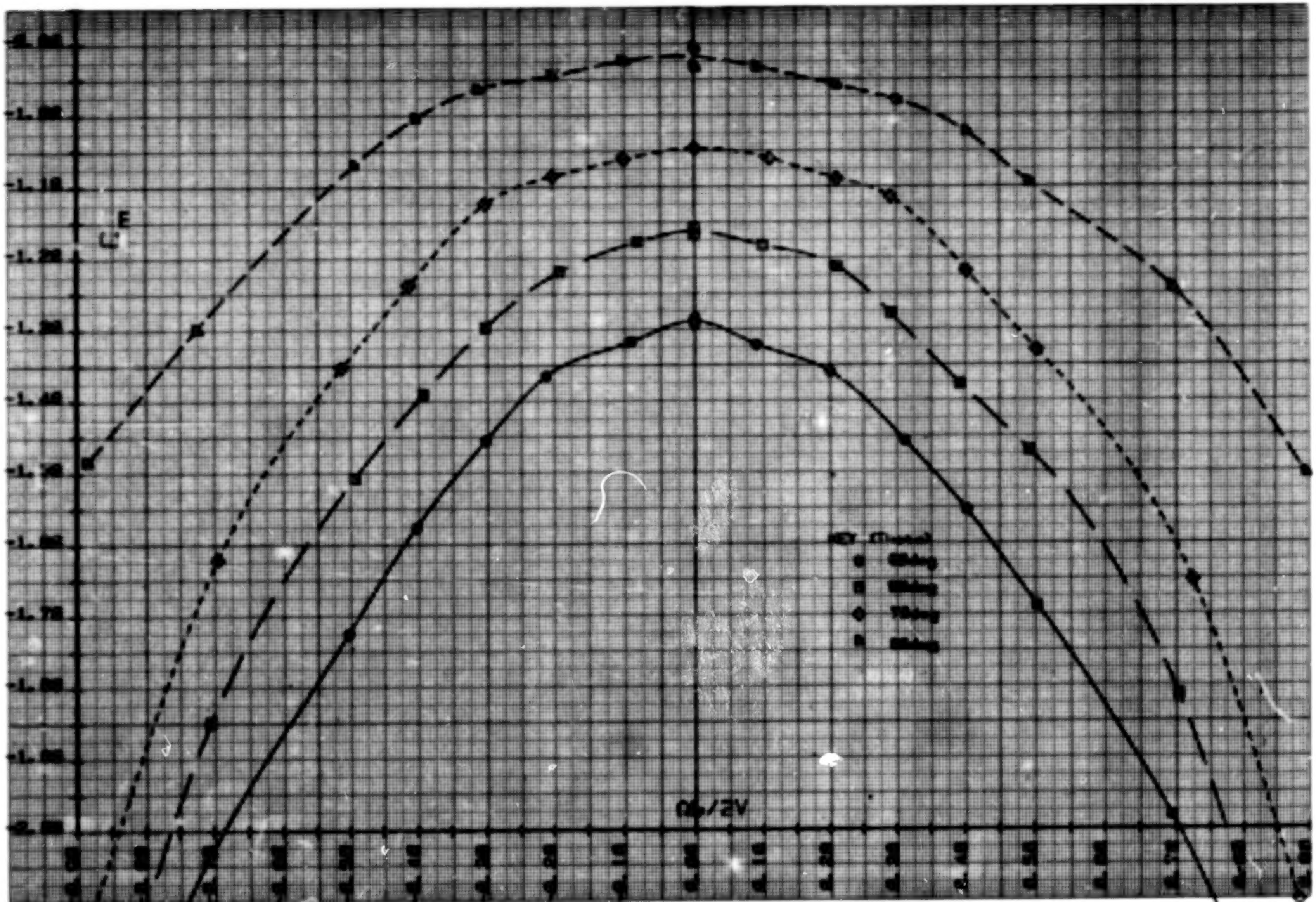


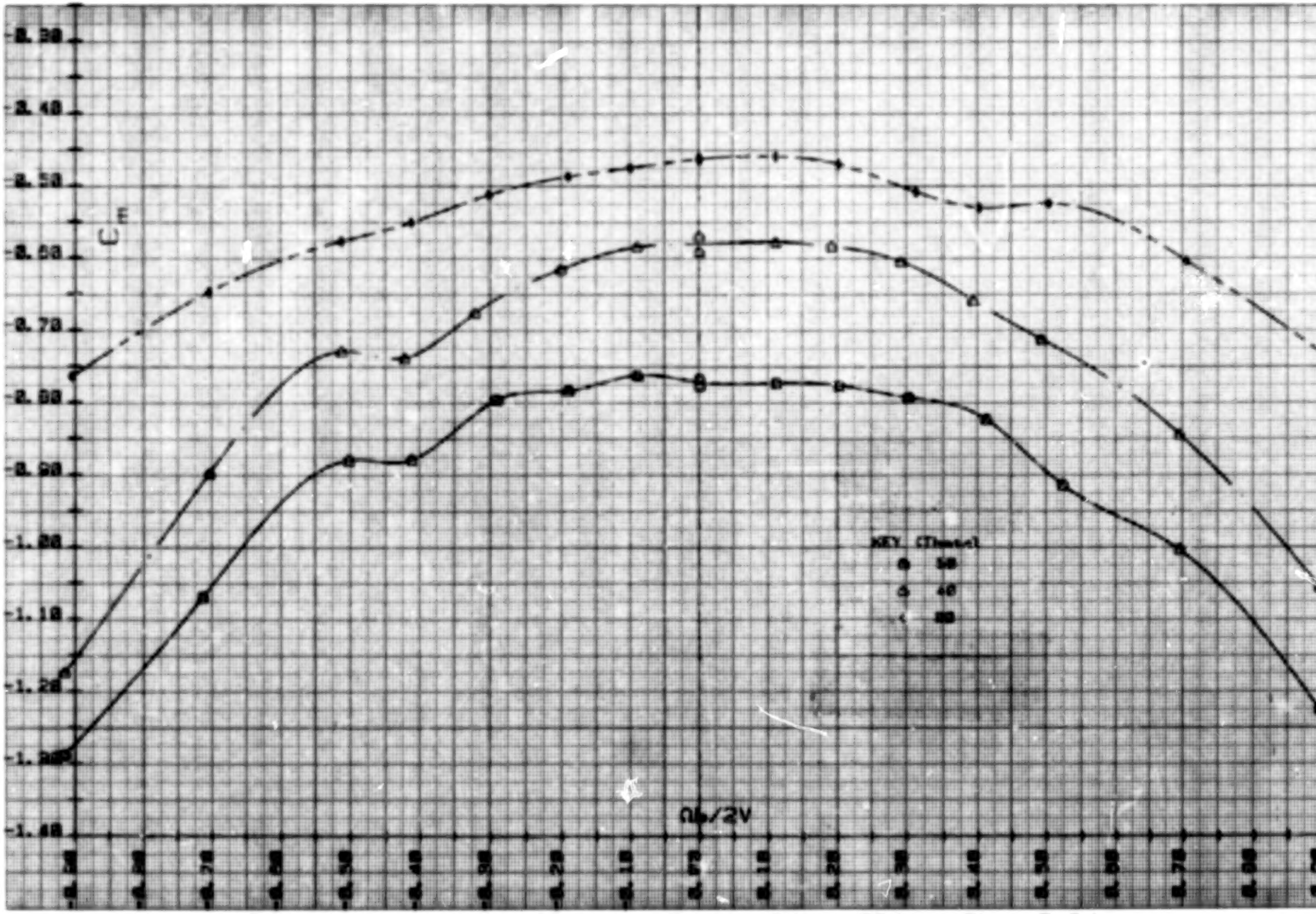
d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi= 0.3deg.

Figure 44.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp2.



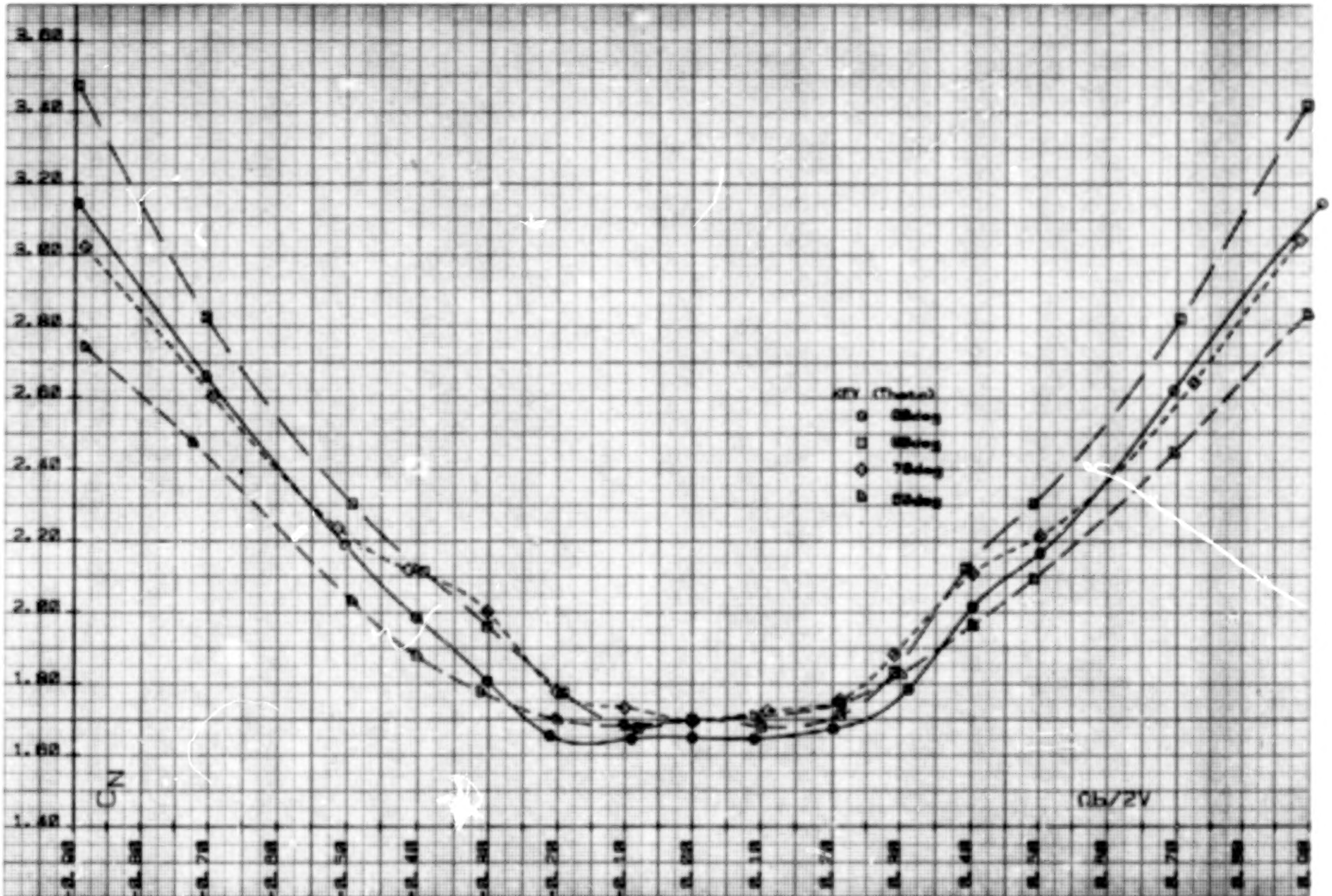
e.) Pitching-moment coefficient, Theta= 60 to 90deg; Phi= 0.2deg.

Figure 44.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp2.



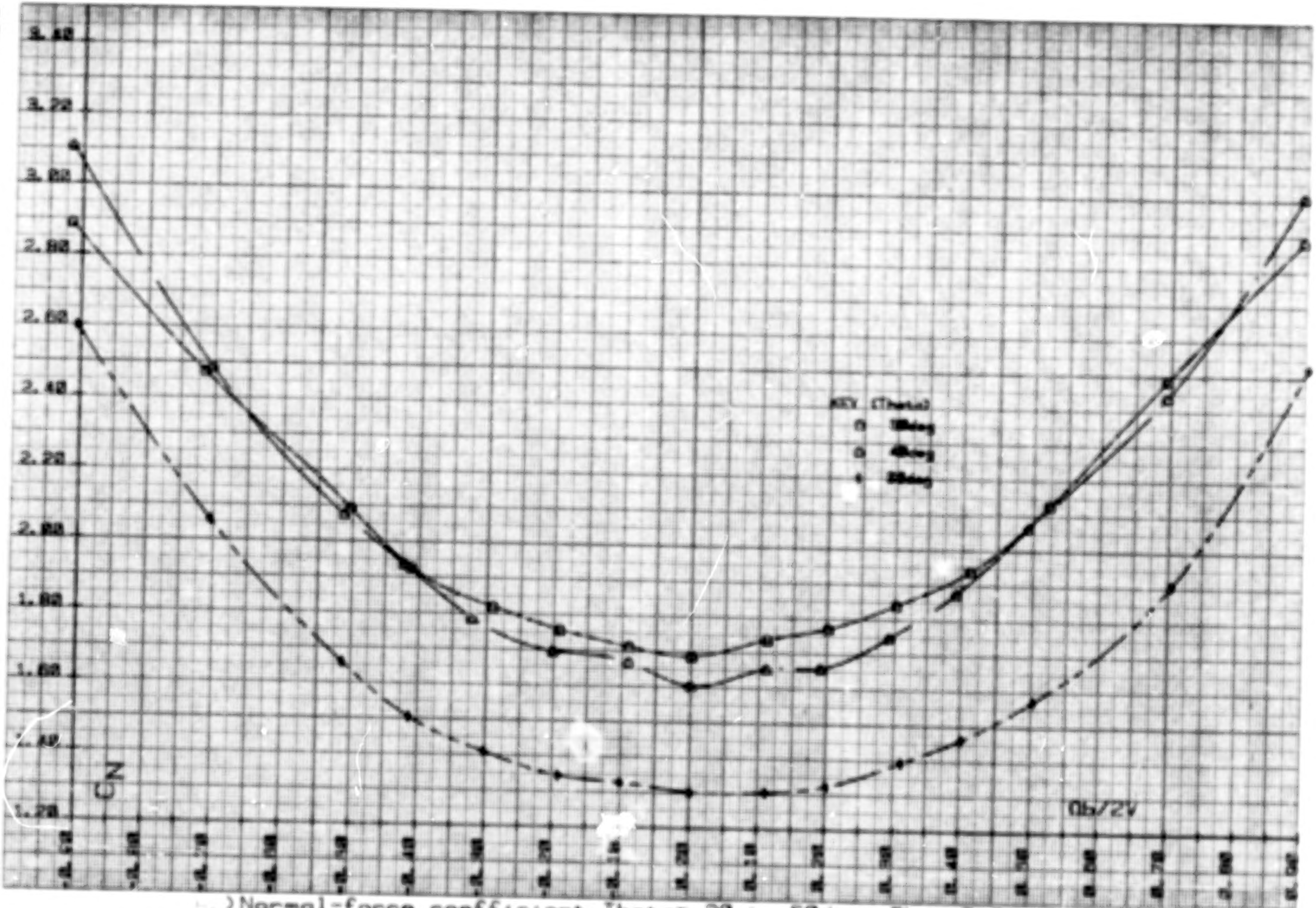
f.) Pitching-moment coefficient. Theta= 30 to 50deg; Phi= 0.3deg.

Figure 44.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp2.



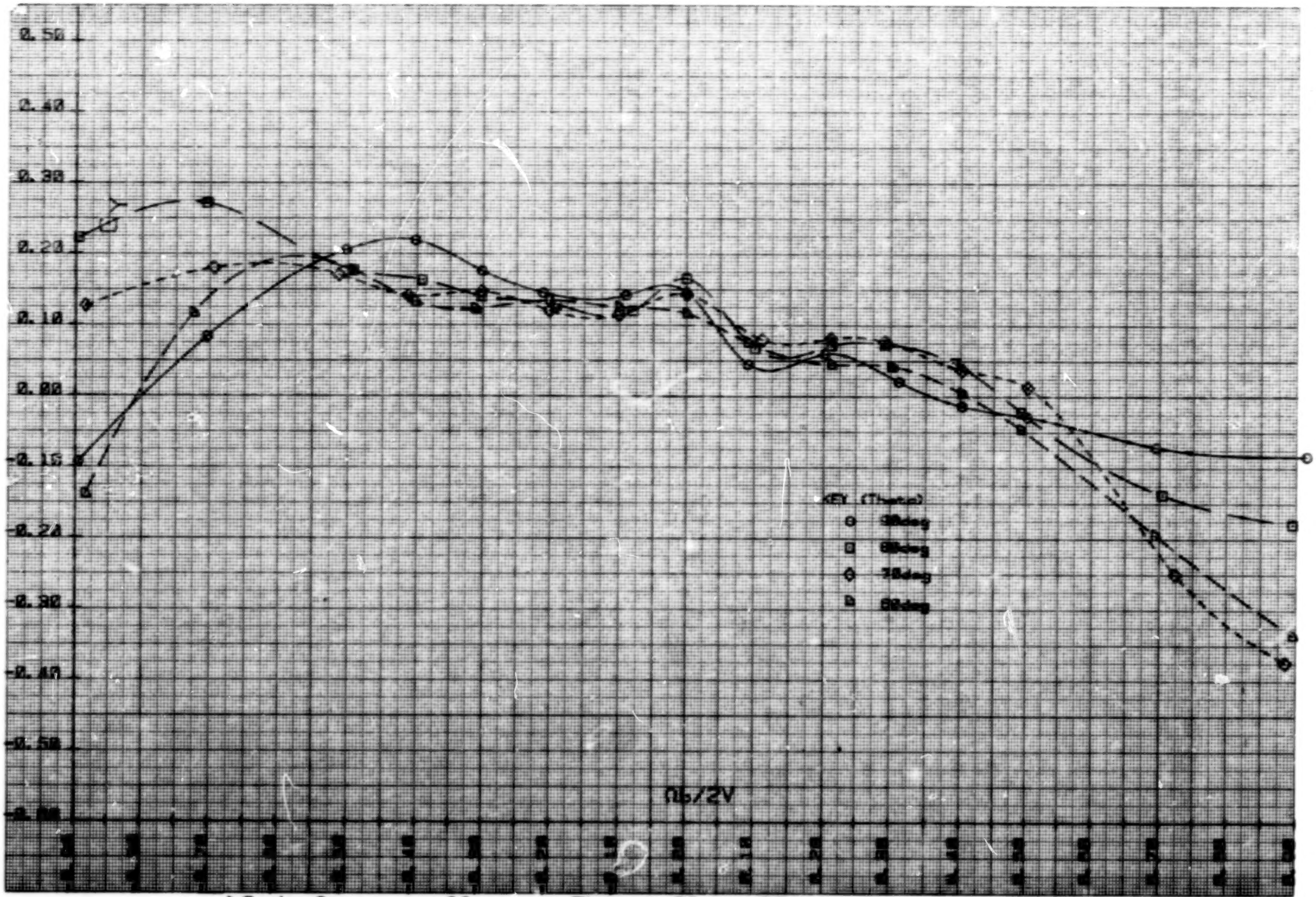
g.) Normal-force coefficient, Theta= 60 to 90deg; Phi=-0.1deg.

Figure 44.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp2.



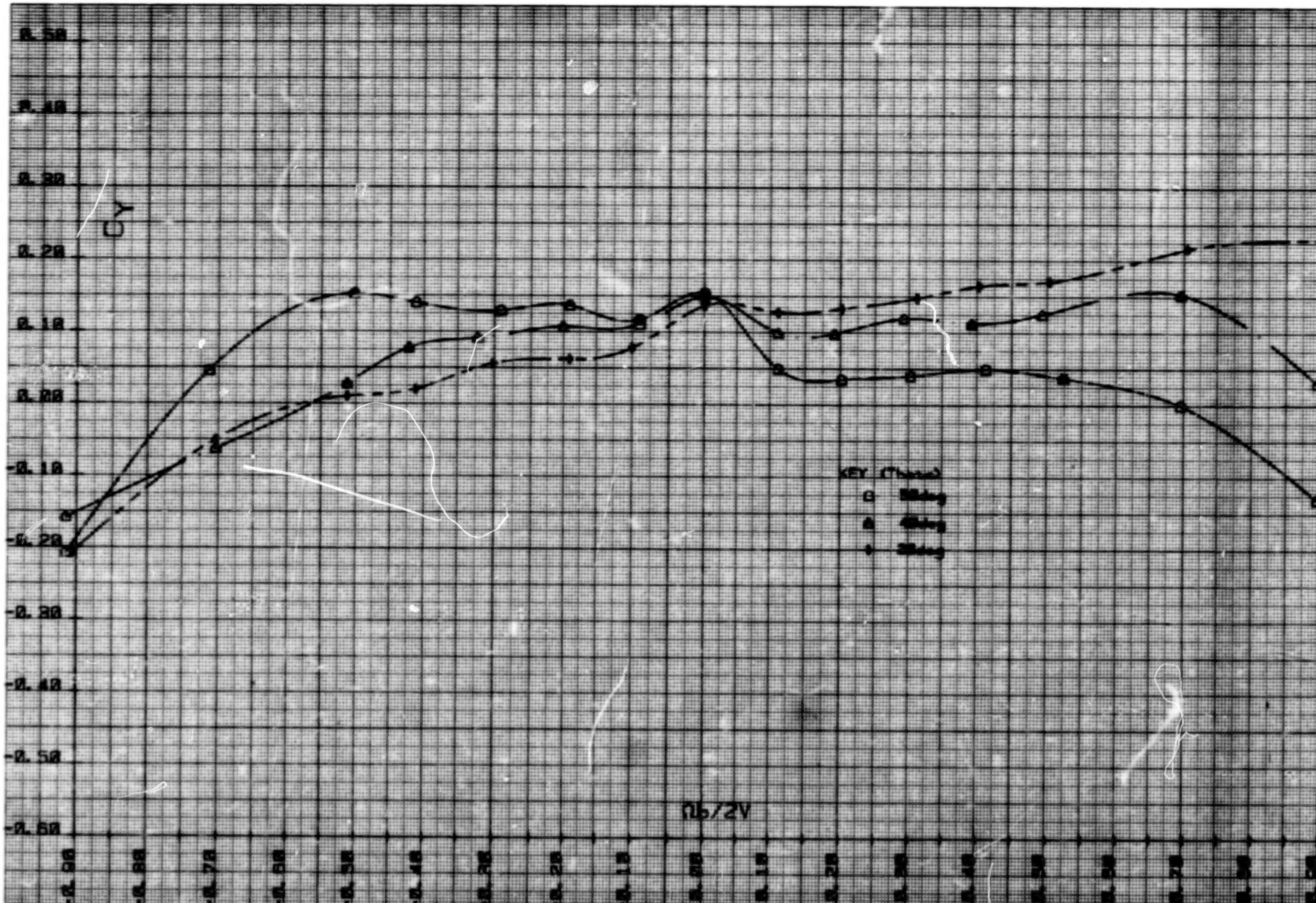
(c) Normal-force coefficient, Theta= 30 to 50deg; Phi= 0.3deg.

Figure 44.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp2.



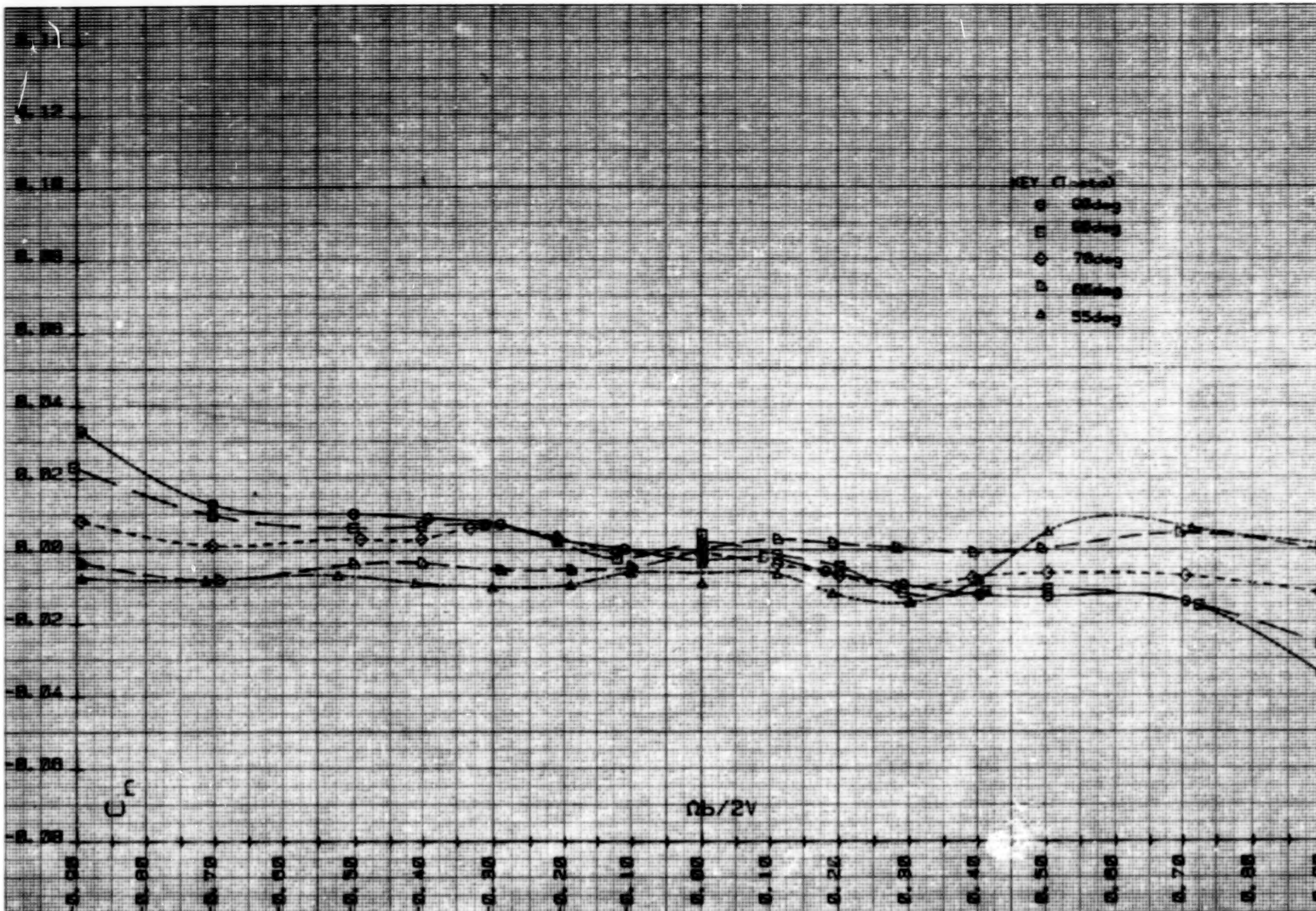
i.) Side-force coefficient, Theta= 60 to 90deg; Phi= 0.2deg.

Figure 44.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp2.



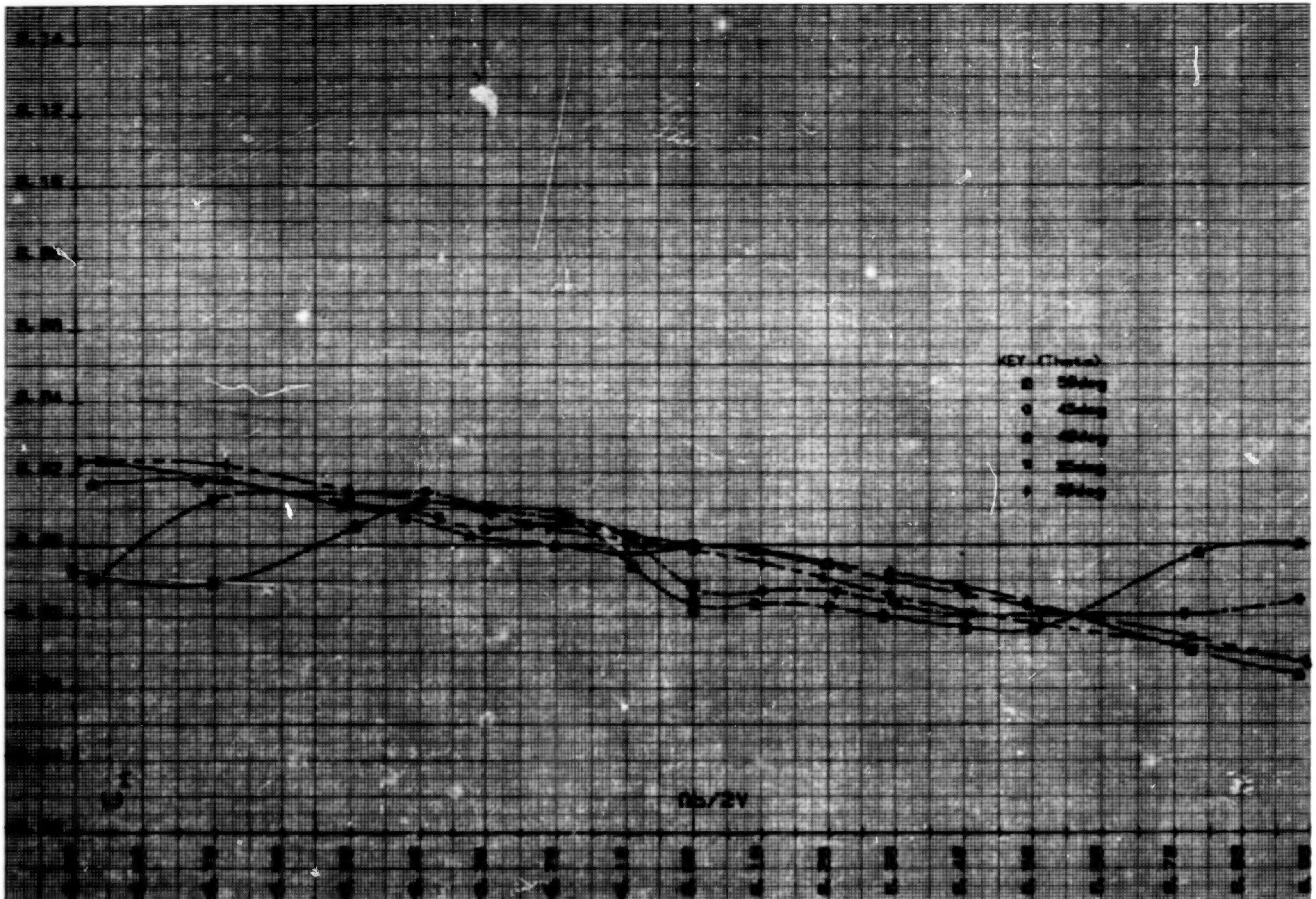
j) Side-force coefficient, Theta= 30 to 50deg; Phi= 0.3deg.

Figure 44.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H4V+Sp2.



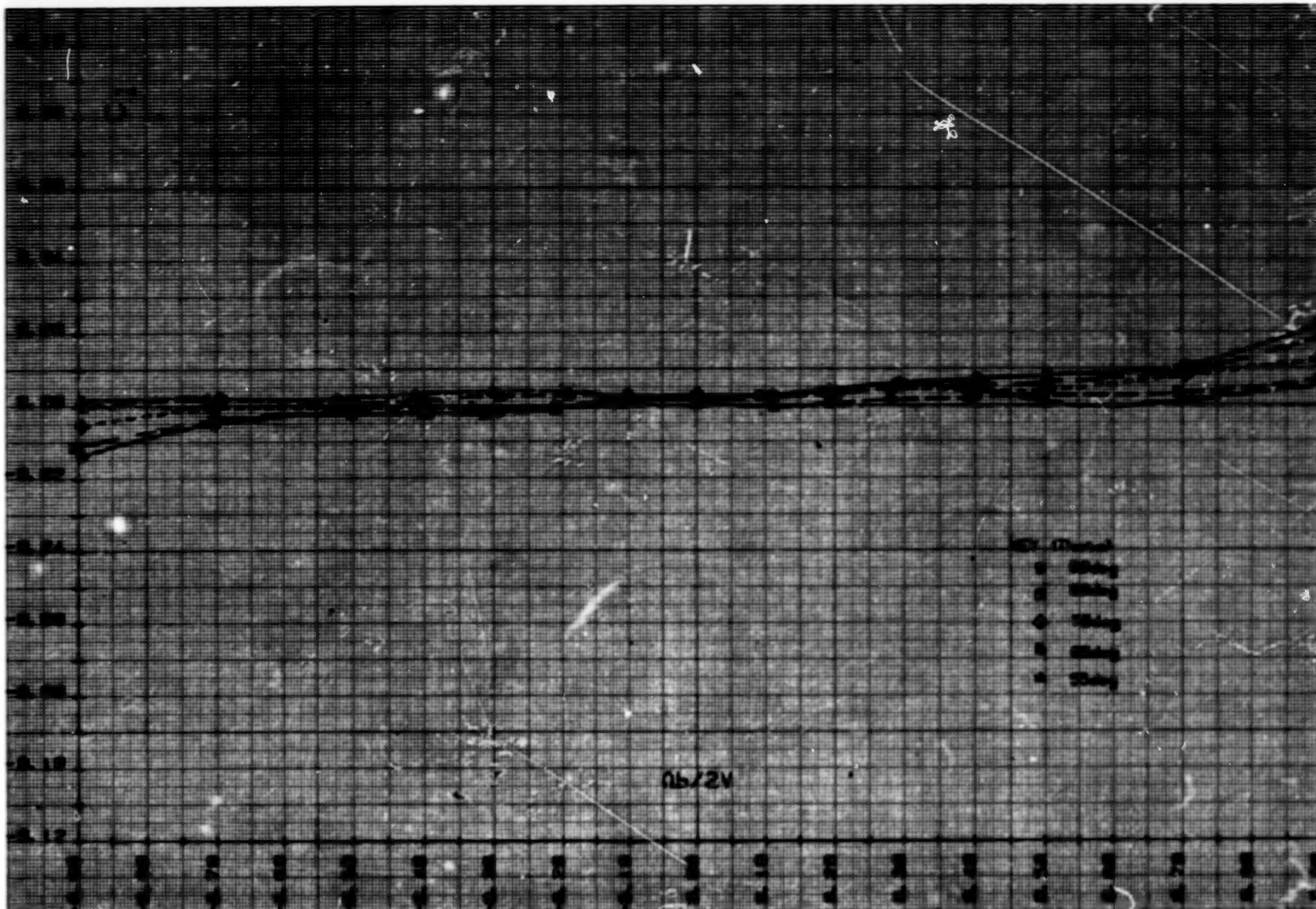
a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

Figure 45.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3V.



b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 45.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3V.



c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

Figure 45.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3V.

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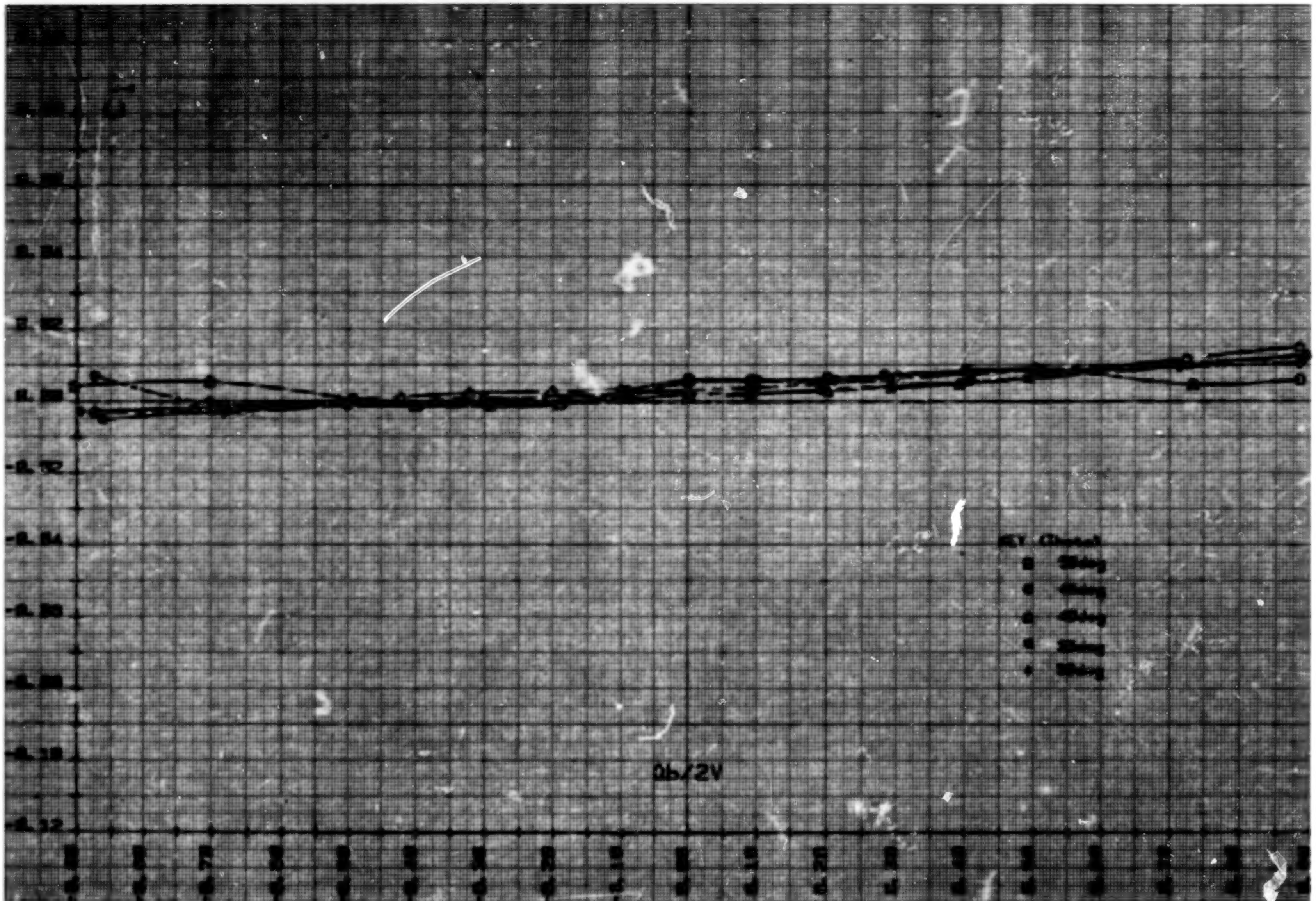
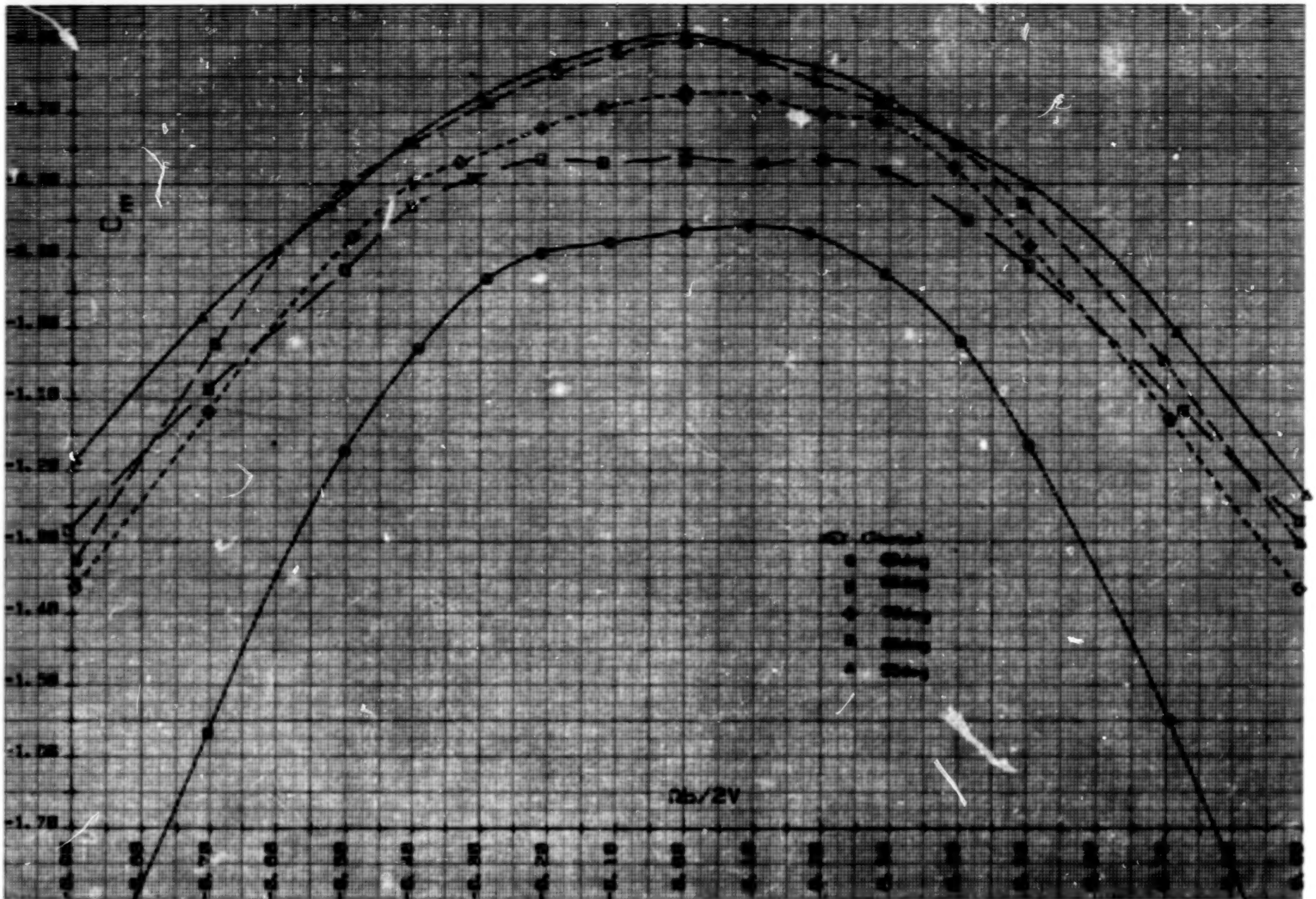


d.) Rolling-moment coefficient. Theta= 30 to 50deg; Phi=-0.4deg.

Figure 45.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3V.



e.)Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 45.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3V.

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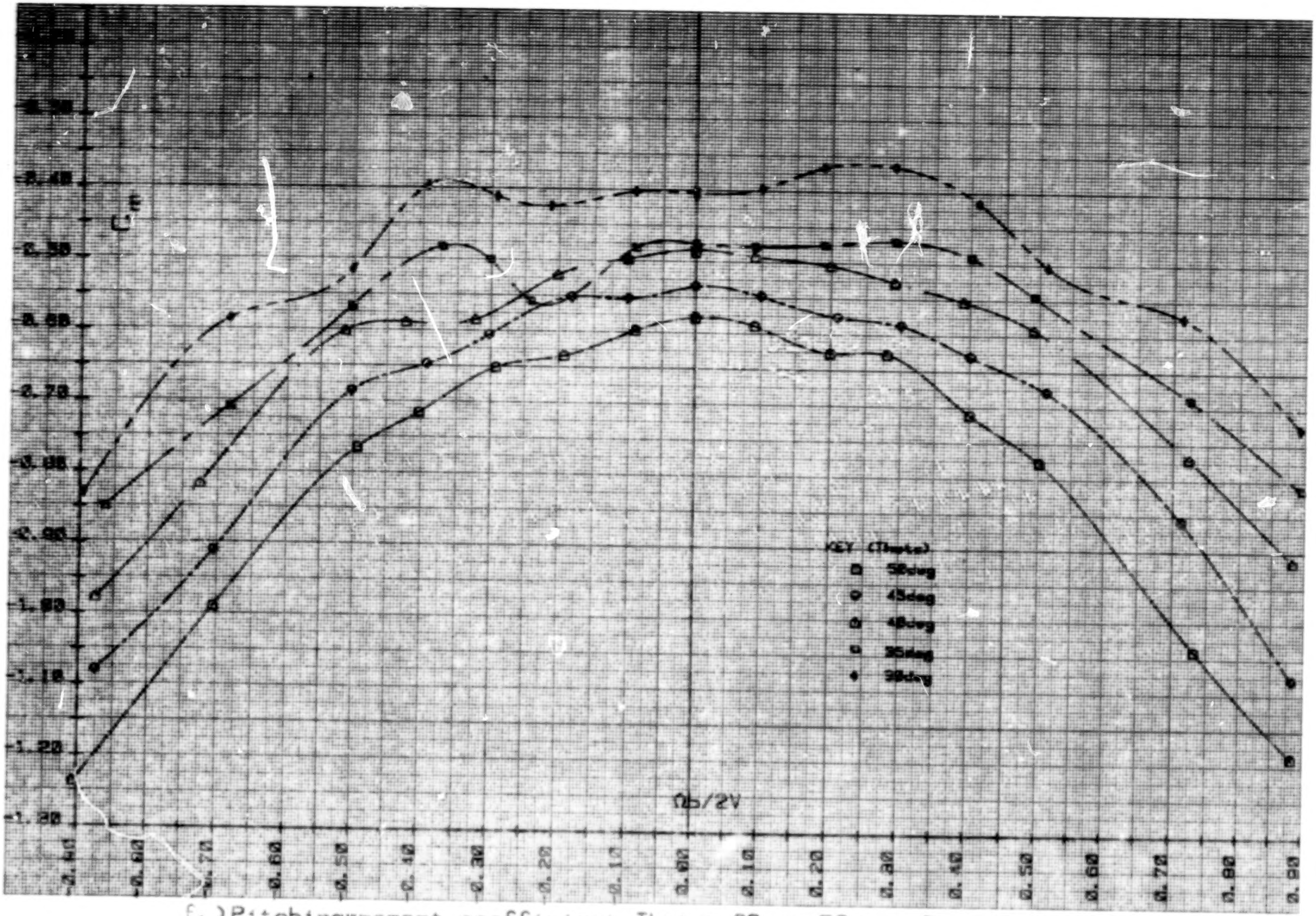
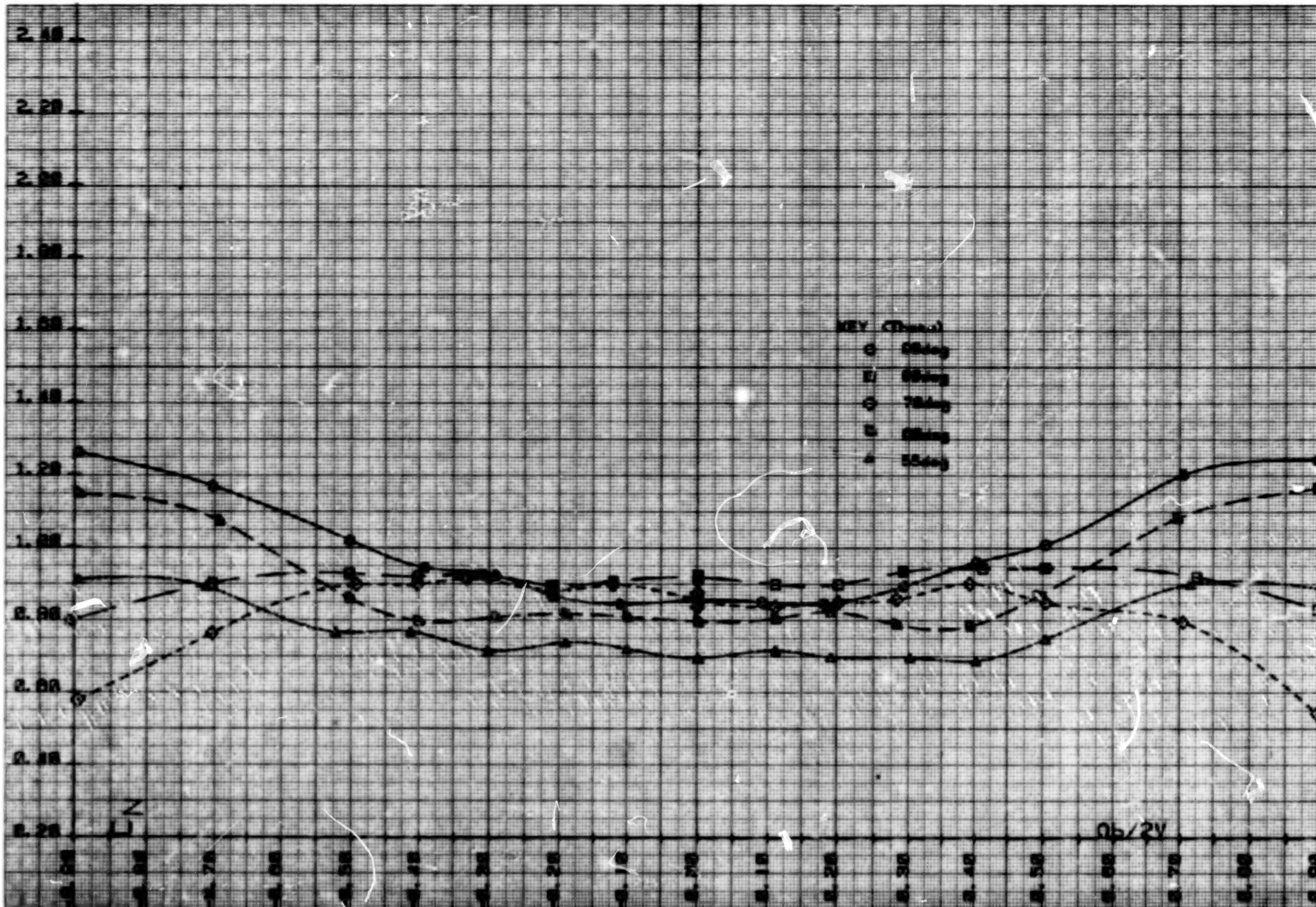


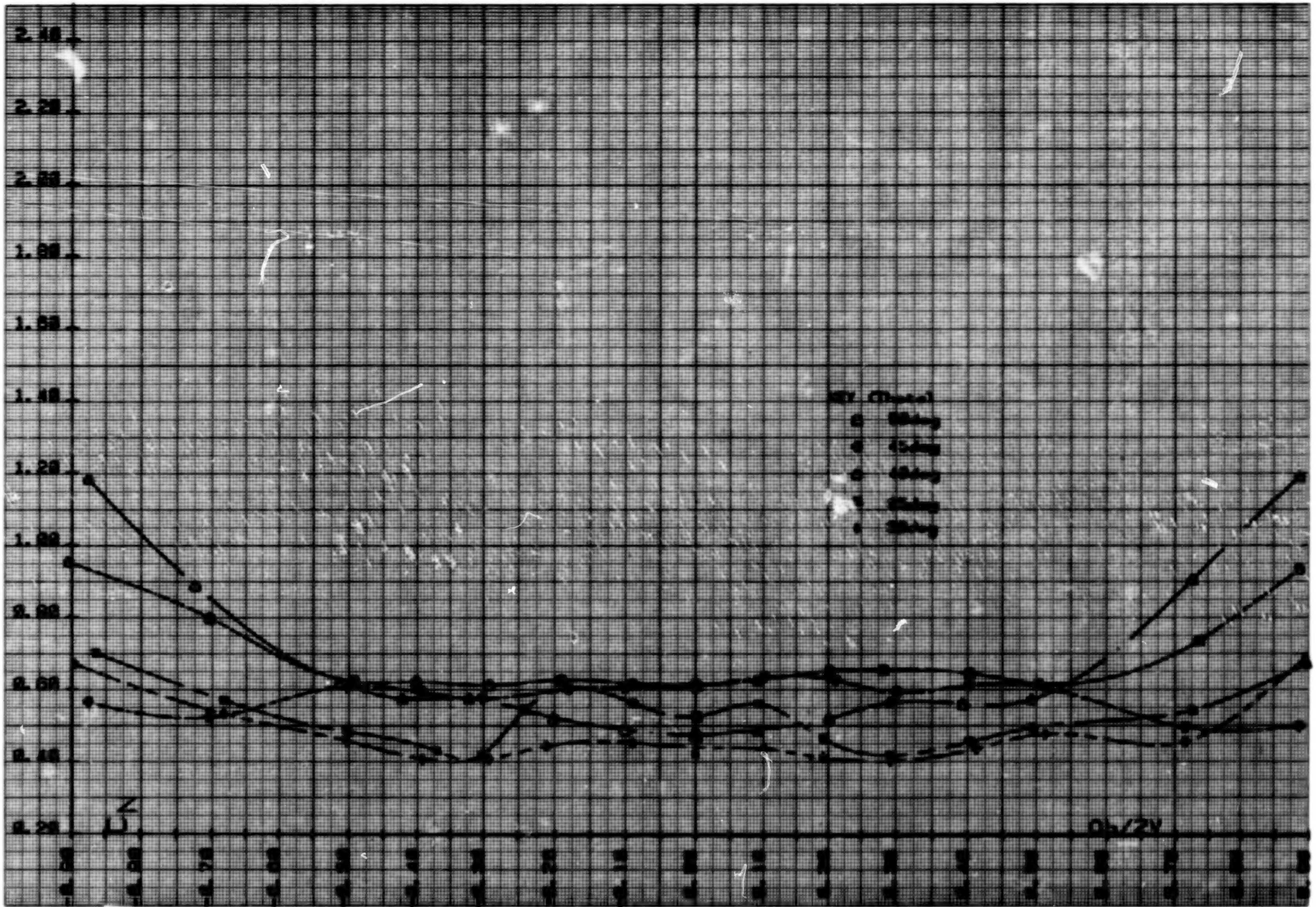
f.) Pitching-moment coefficient, Theta= 30 to 50deg: Phi=-0.2deg.

Figure 45.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3V.



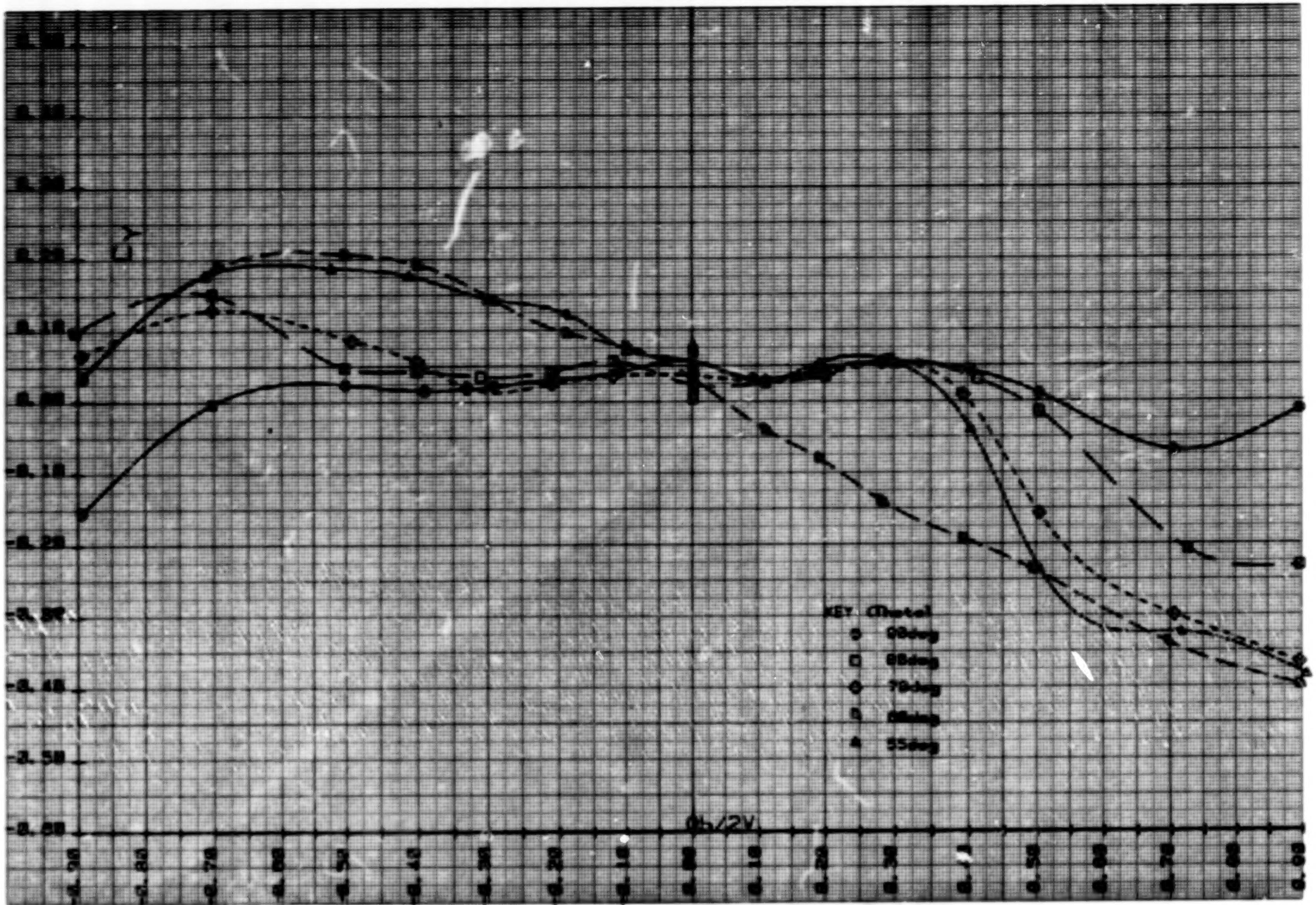
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

Figure 45 .-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3V.



h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 45. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3V.



(.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 45.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3V.

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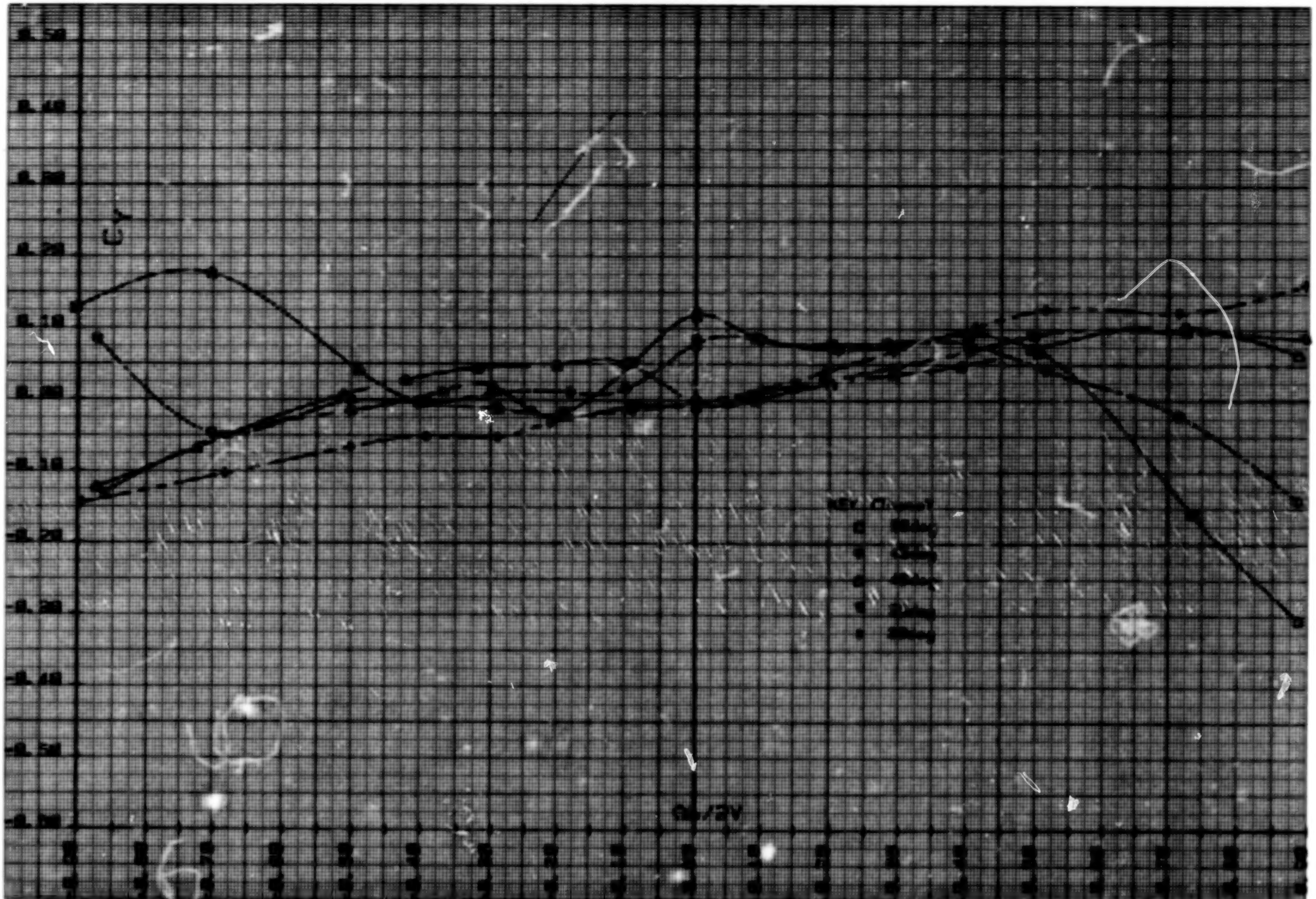
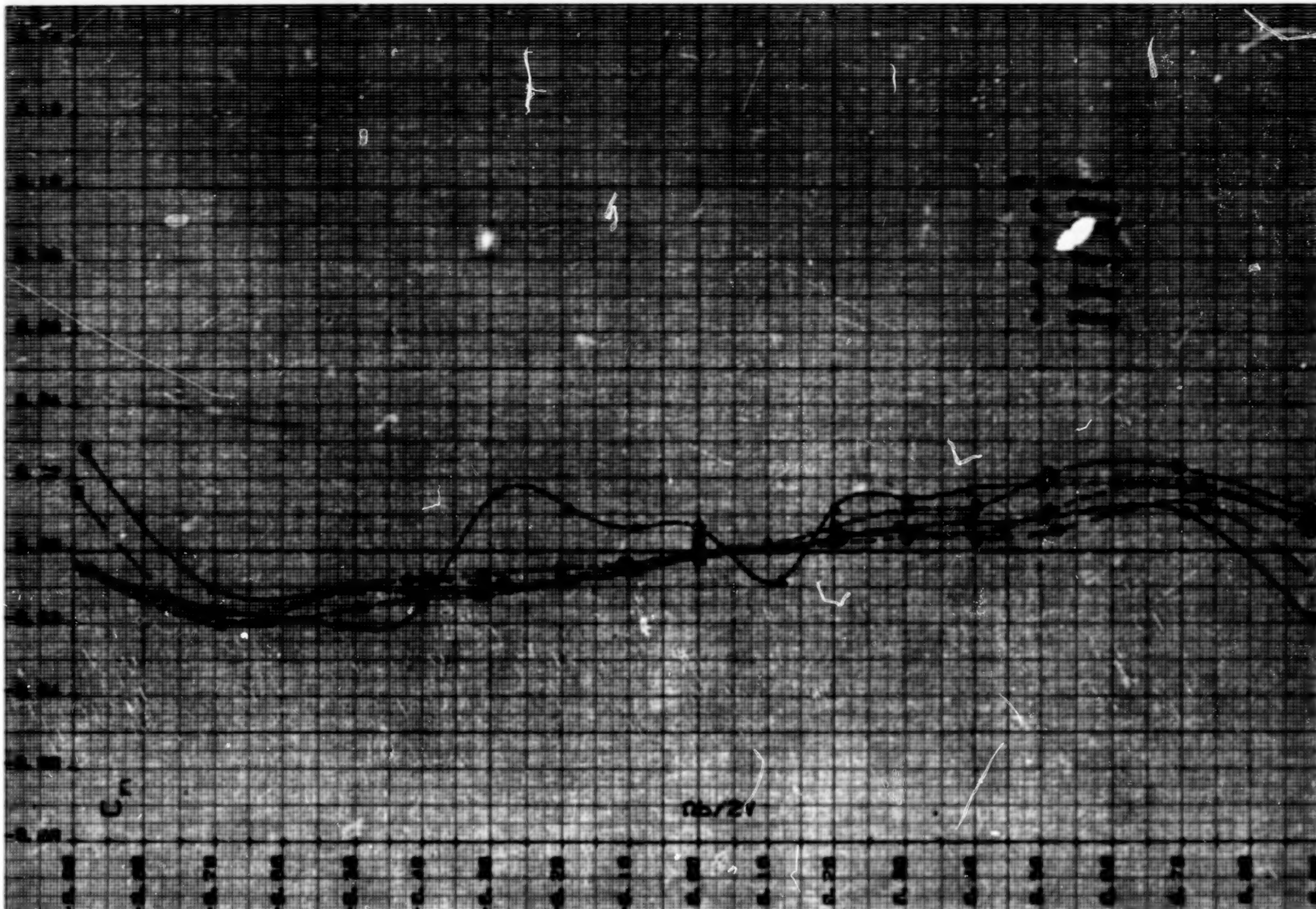


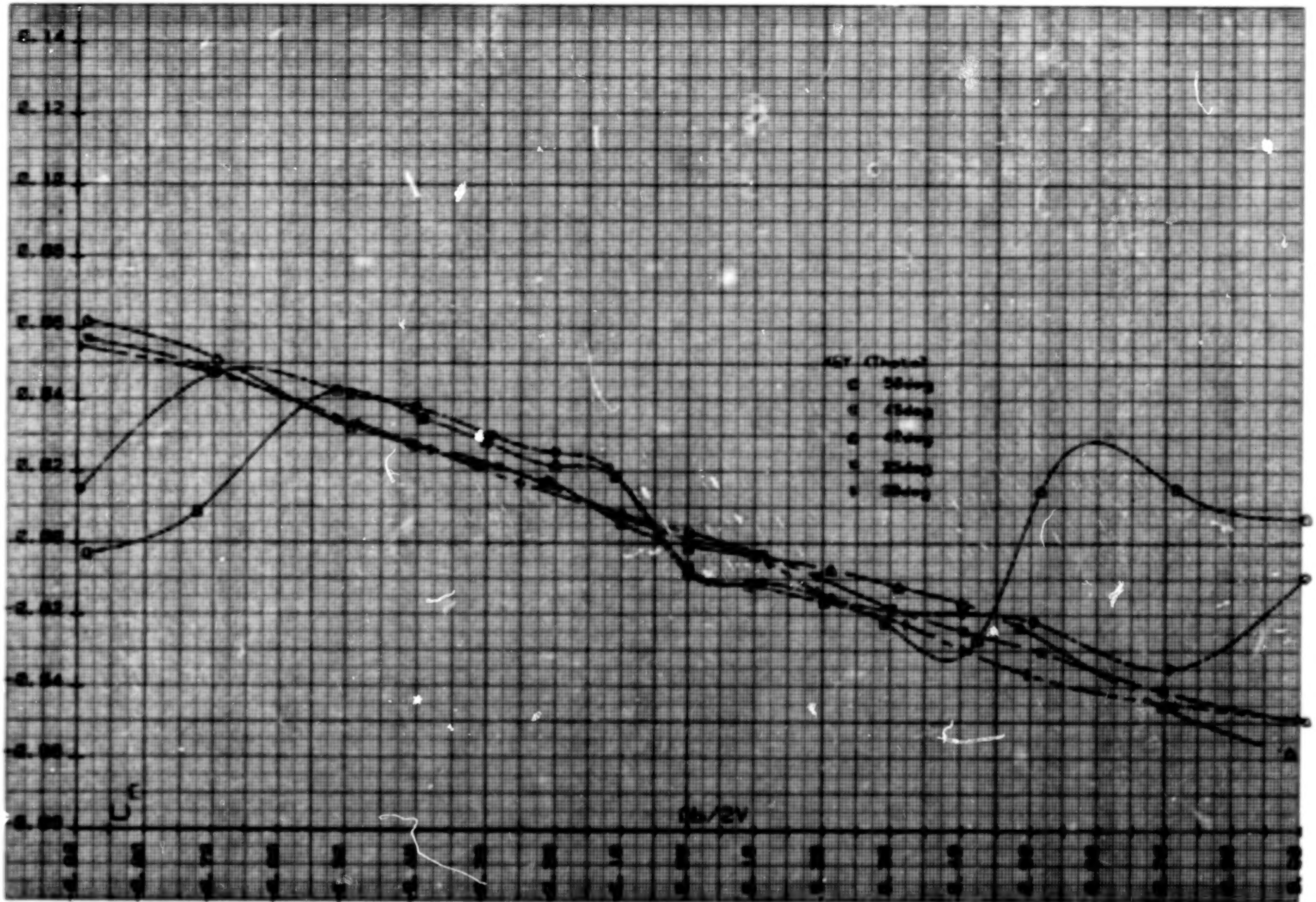
(j) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 45.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3V.



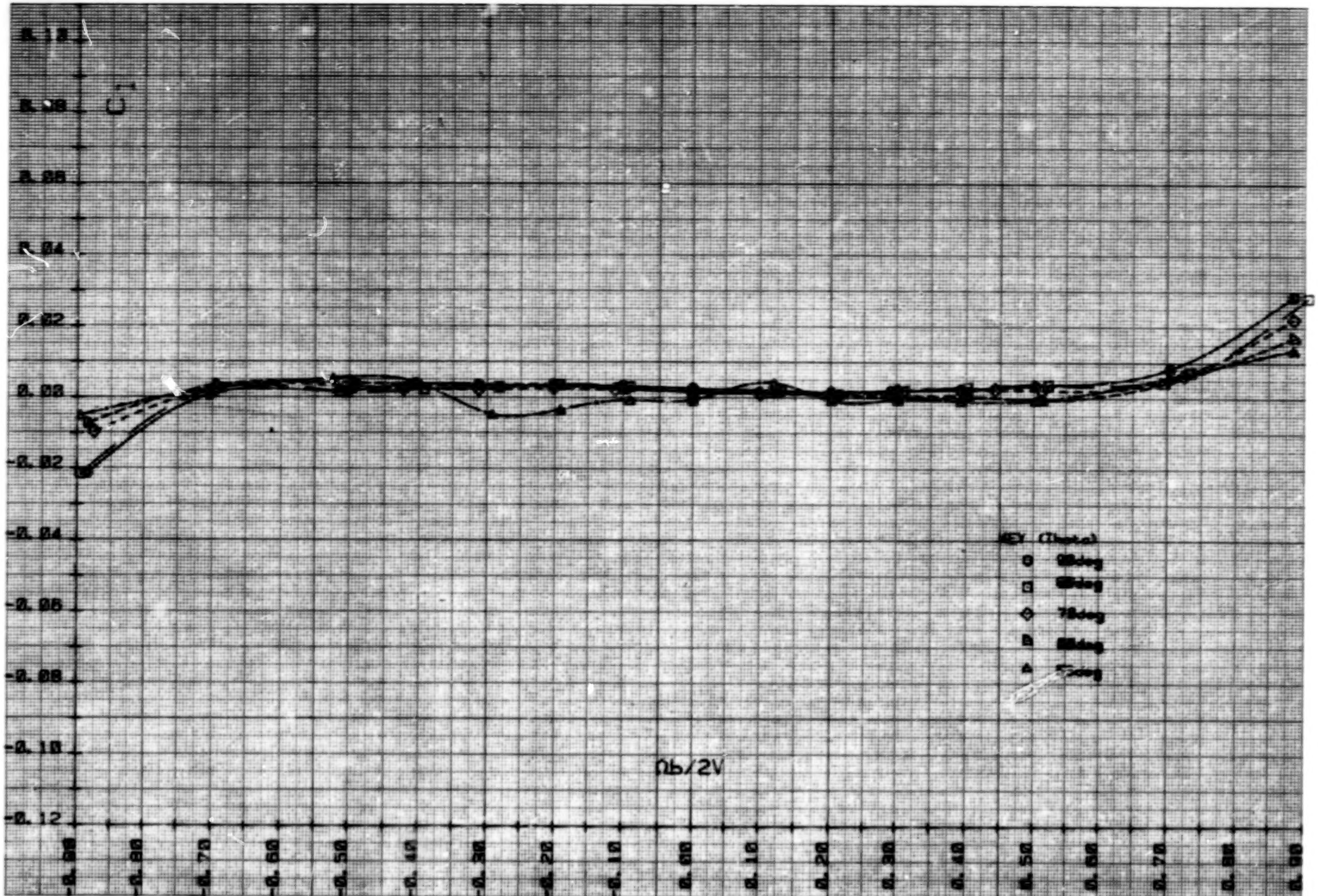
a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.0deg.

Figure 46.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH4V.



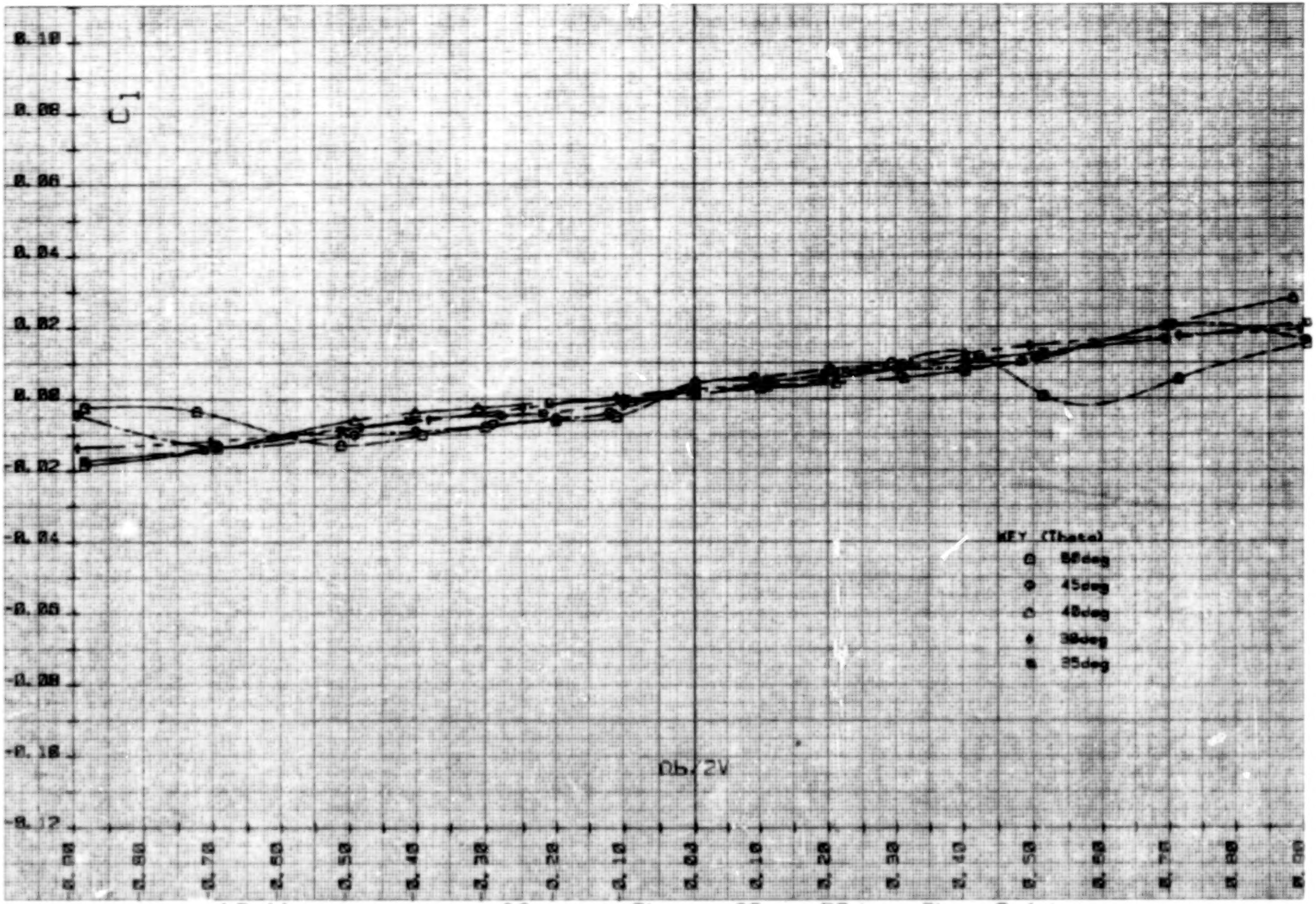
b.) Yawing-moment coefficient. Theta= 30 to 50deg; Phi= 0.1deg.

Figure 46.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH4V.



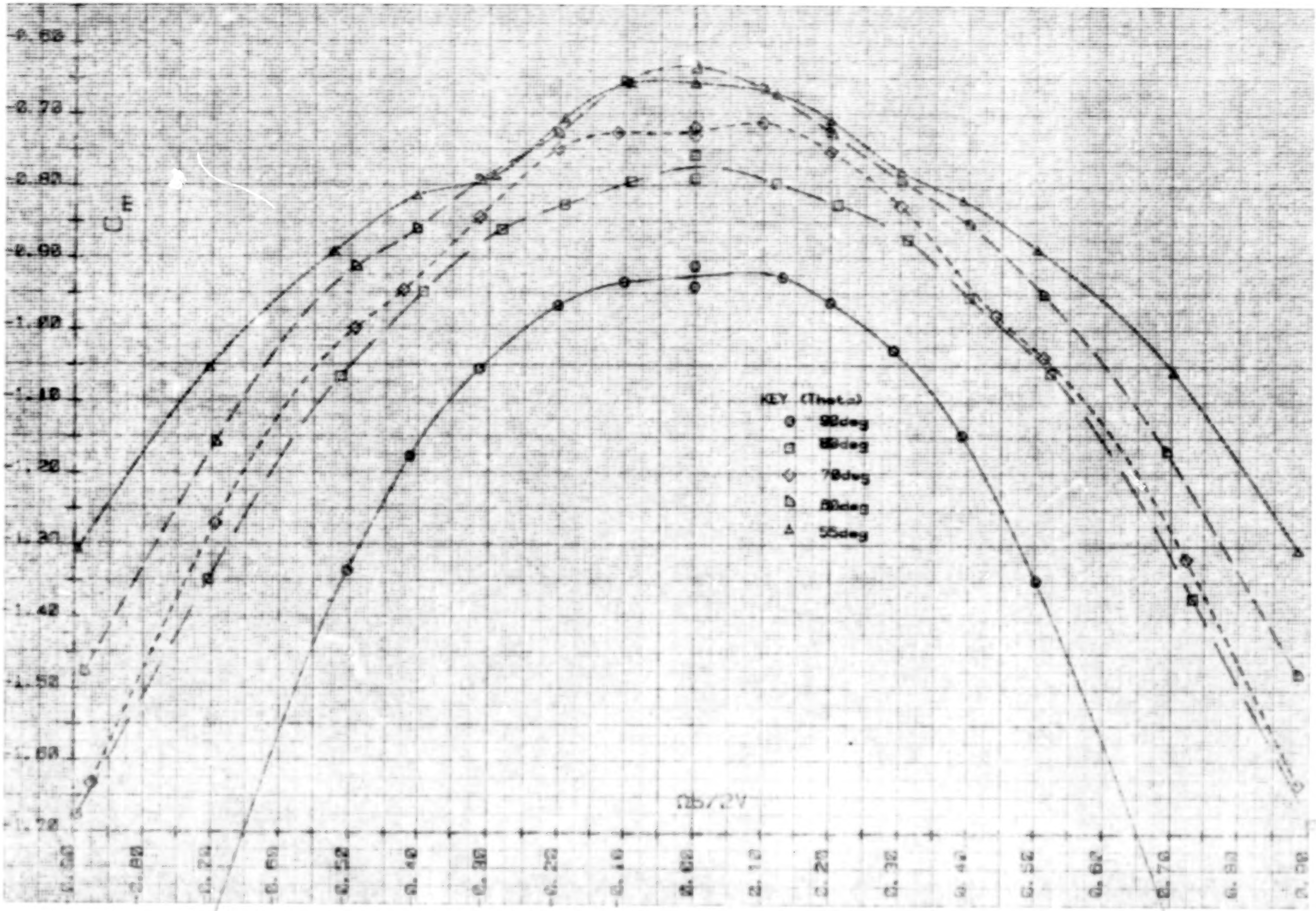
c.)Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.0deg.

Figure 46.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH4V.



d.)Rolling-moment coefficient, Theta= 30 to 50deg; Phi= 0.1deg.

Figure 46.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH4V.



Pitching-moment coefficient, Theta= 55 to 90deg; Phi= 0.2deg.

Figure 46. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH4V.

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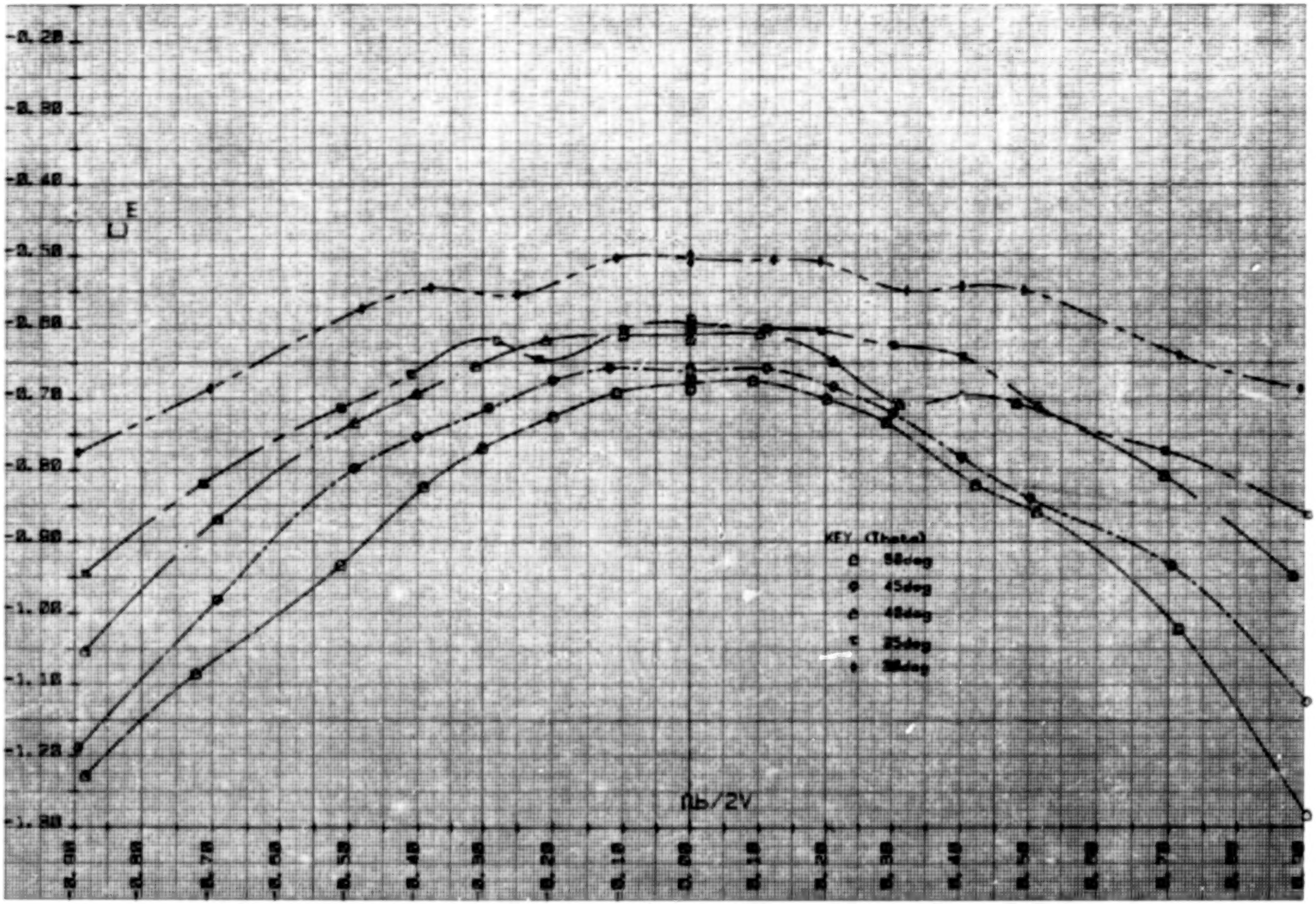
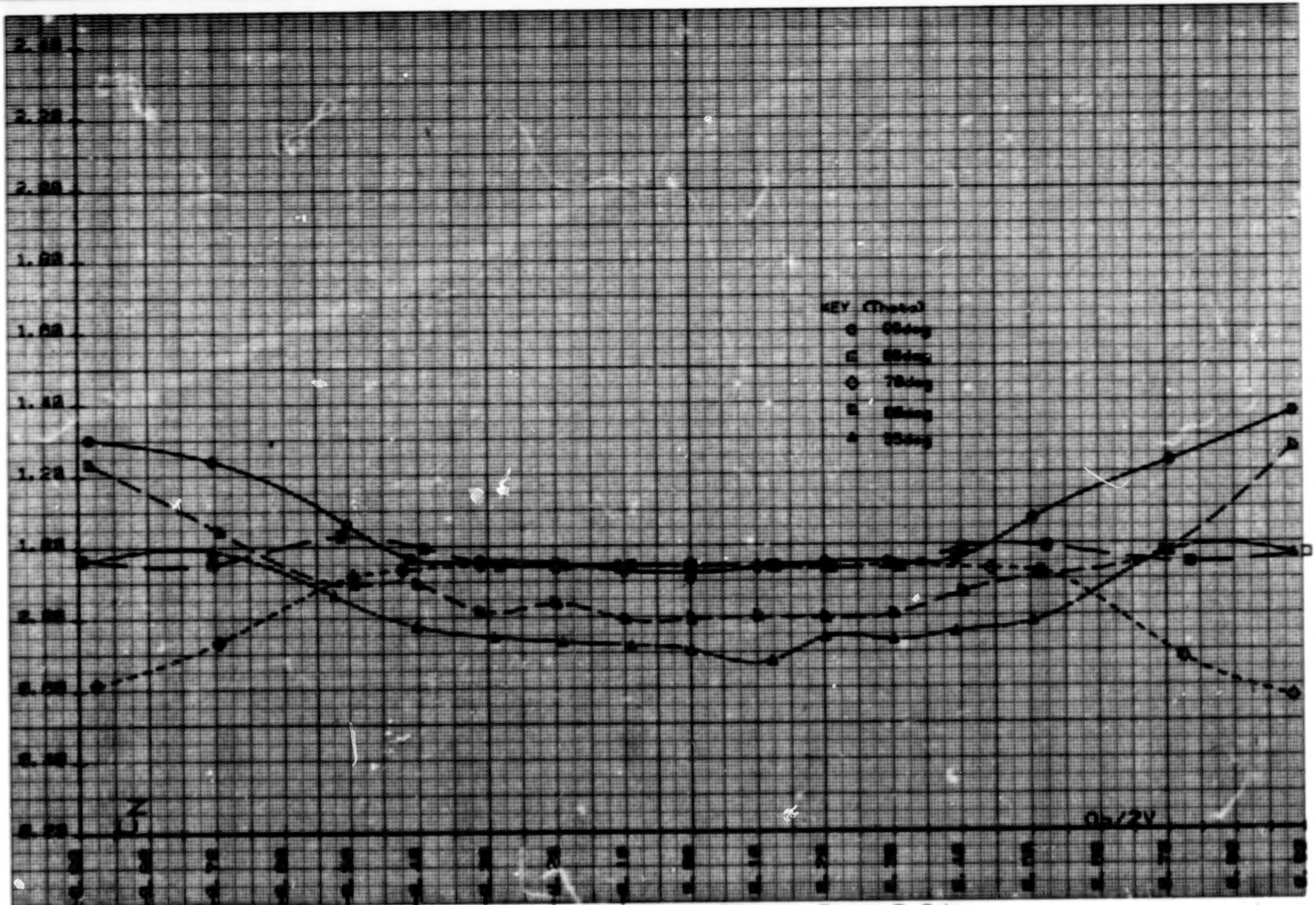


f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi= 0.0deg.

Figure 46. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH4V.



9-) Normal-force coefficient, Theta= 55 to 90deg; Phi= 0.2deg.

Figure 46.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH4V.

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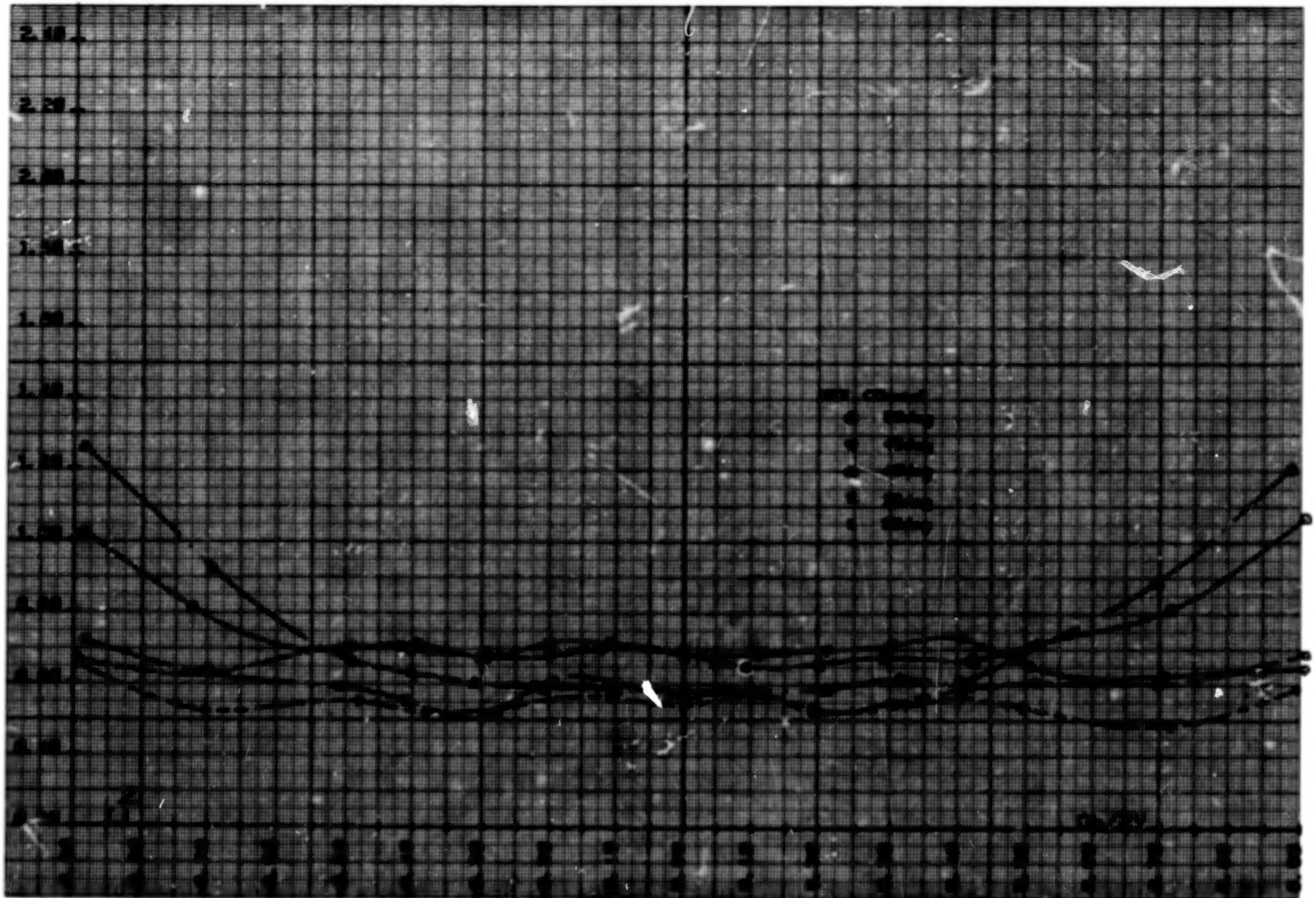
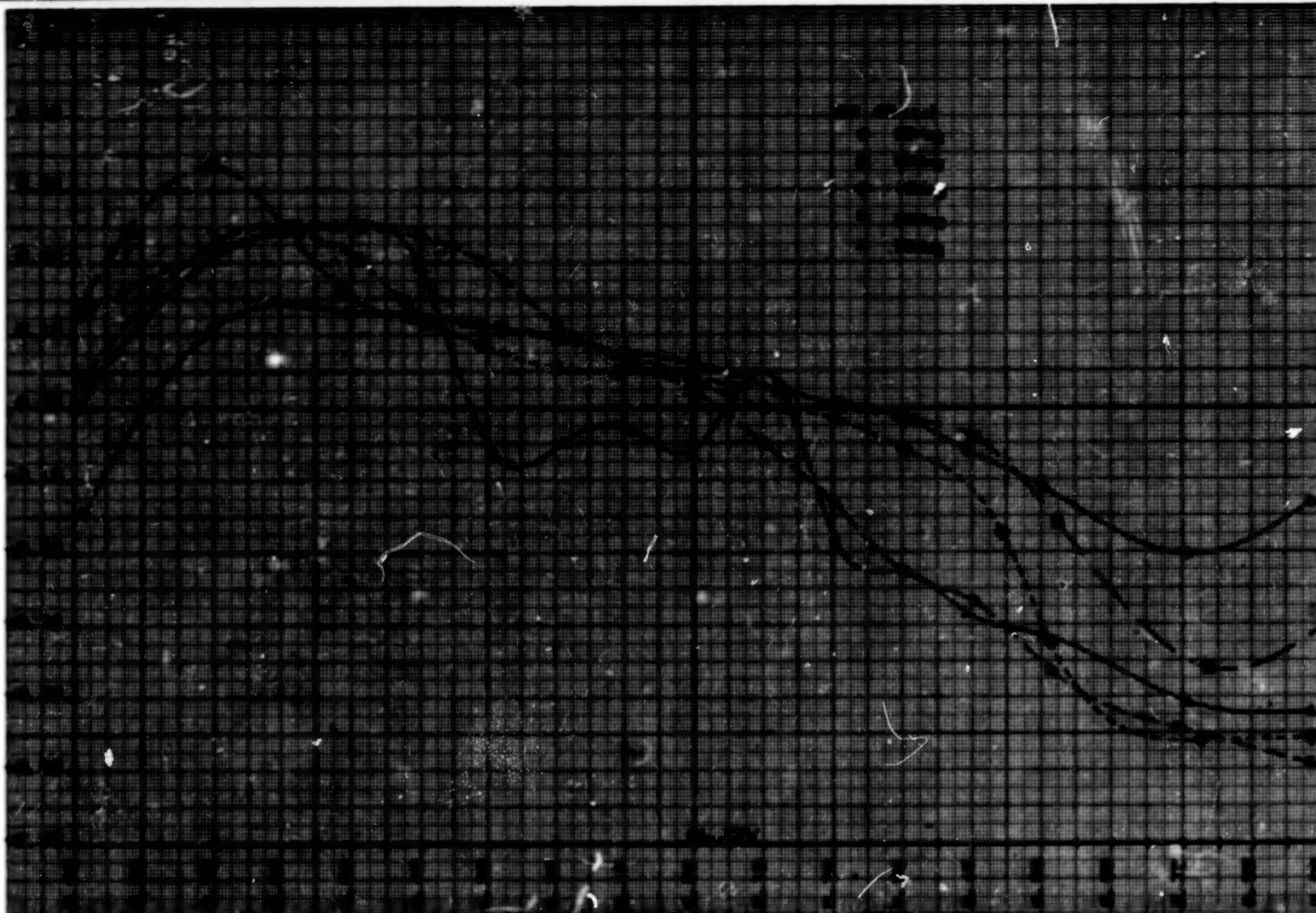


h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.0deg.

Figure 46.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH4V.



i.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.0deg.

Figure 46 .-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH4V.

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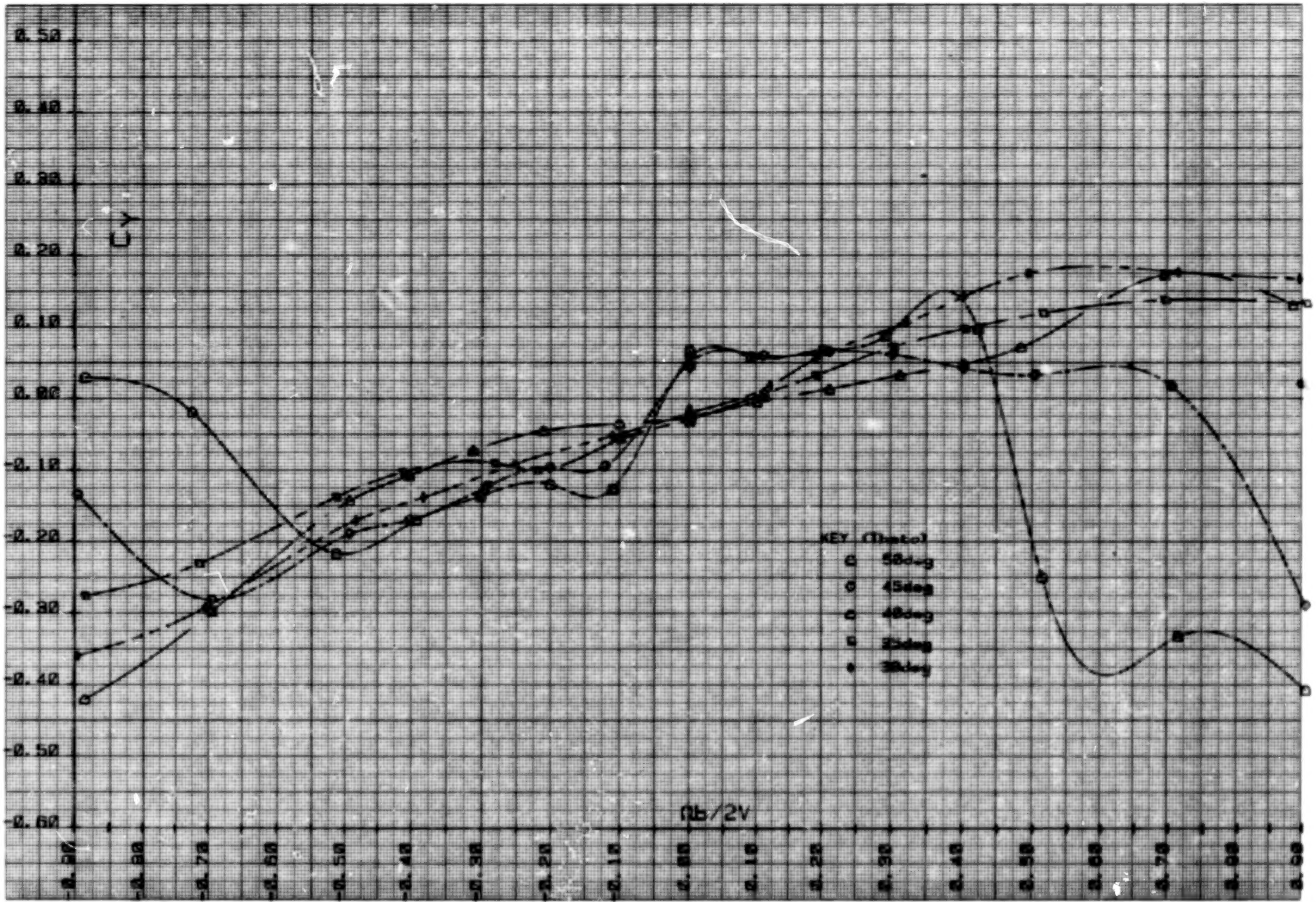
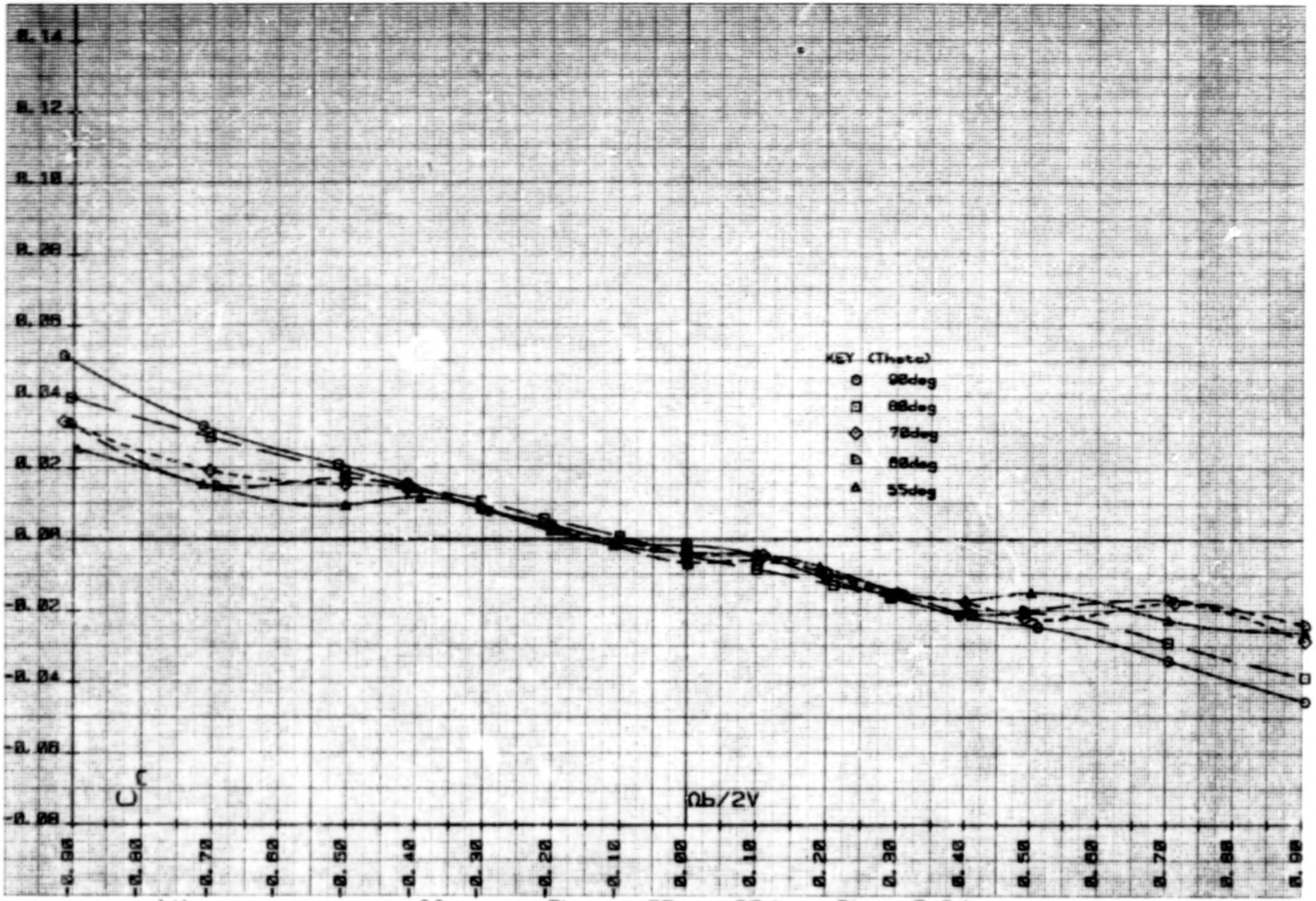


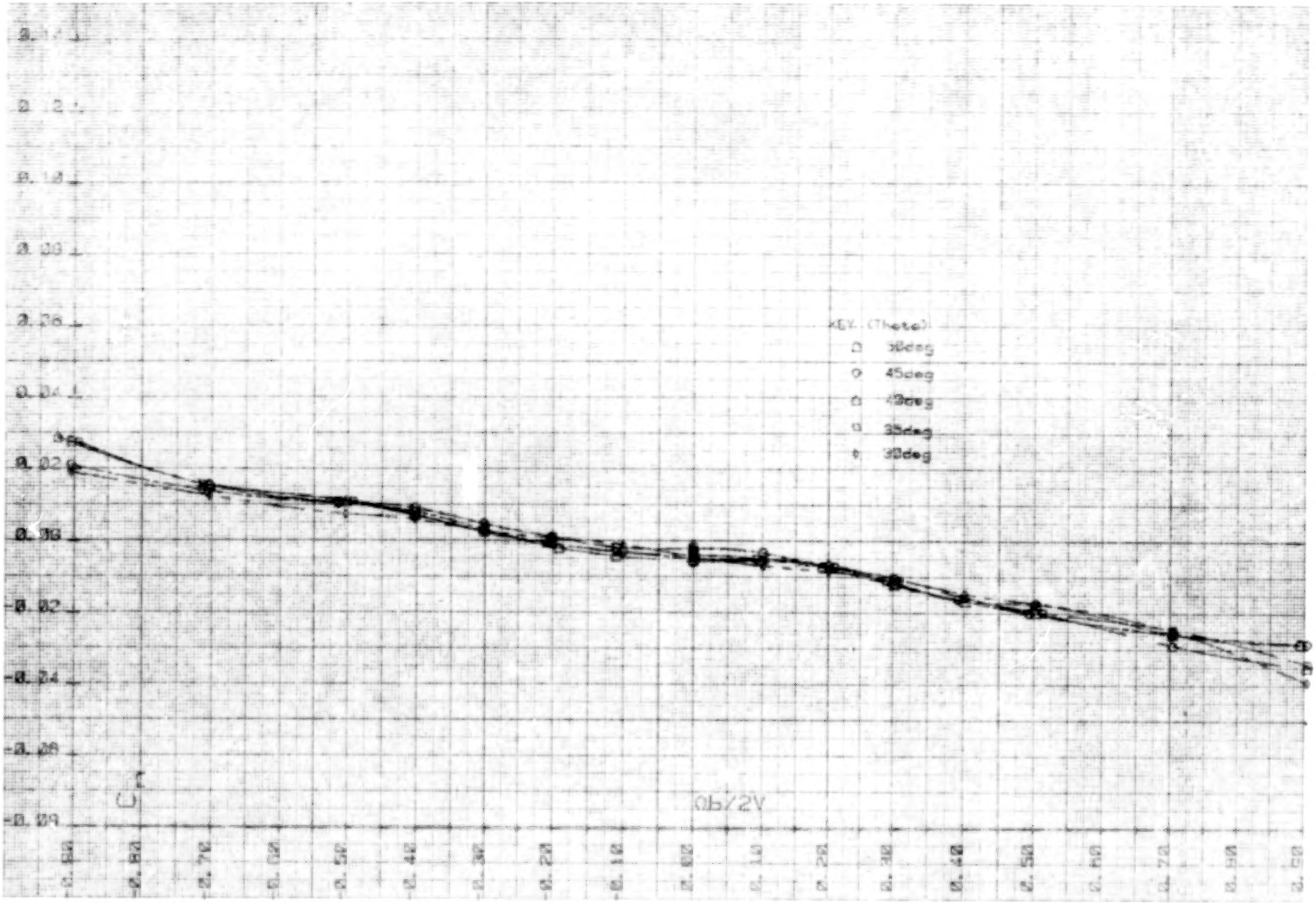
j.) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.0deg.

Figure 46.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH4V.



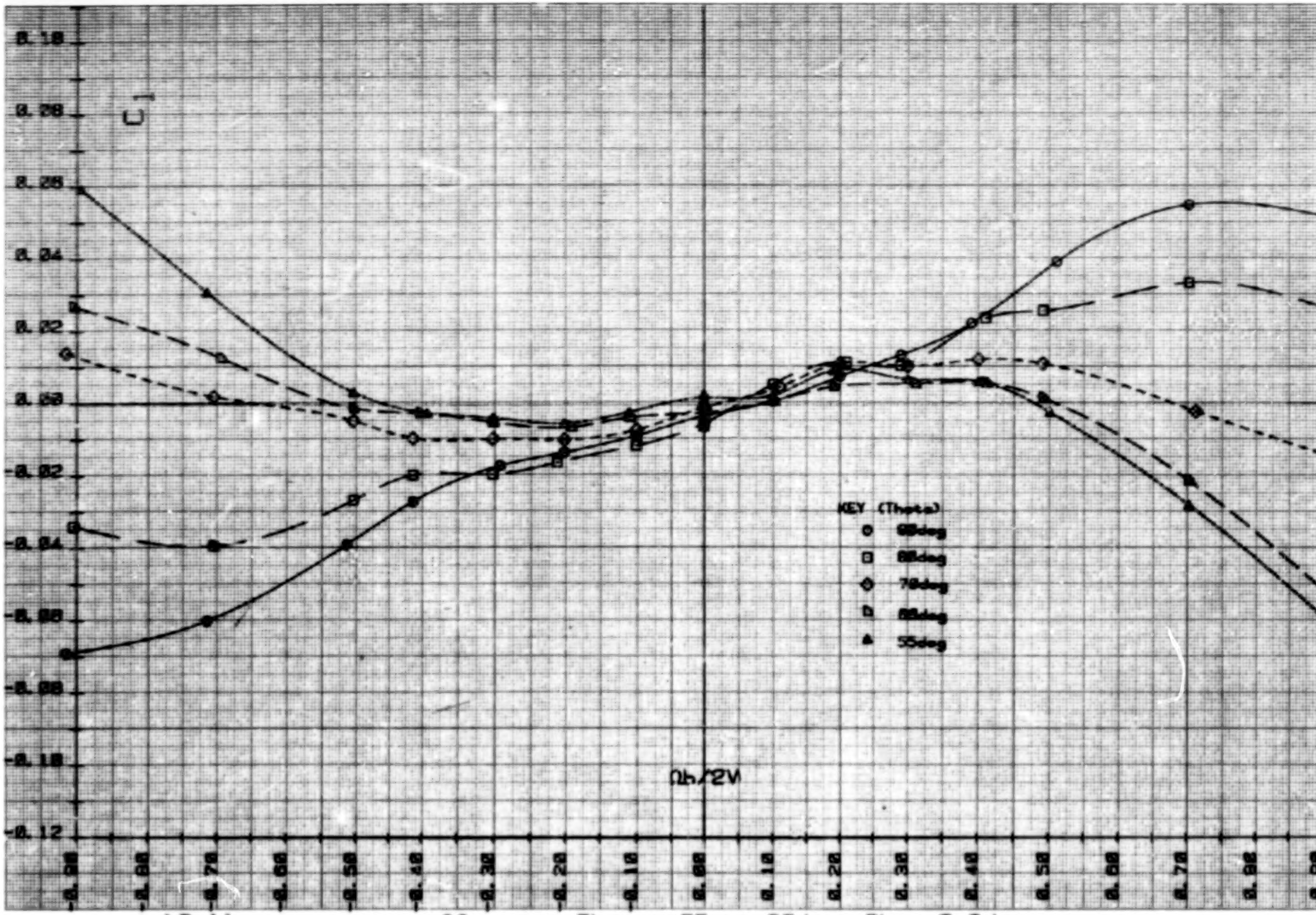
a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 47.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3.



b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi= 0.0deg.

Figure 47.- Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3.



c.) Rolling-moment coefficient. Theta= 55 to 90deg; Phi=-0.3deg.

Figure 47.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3.

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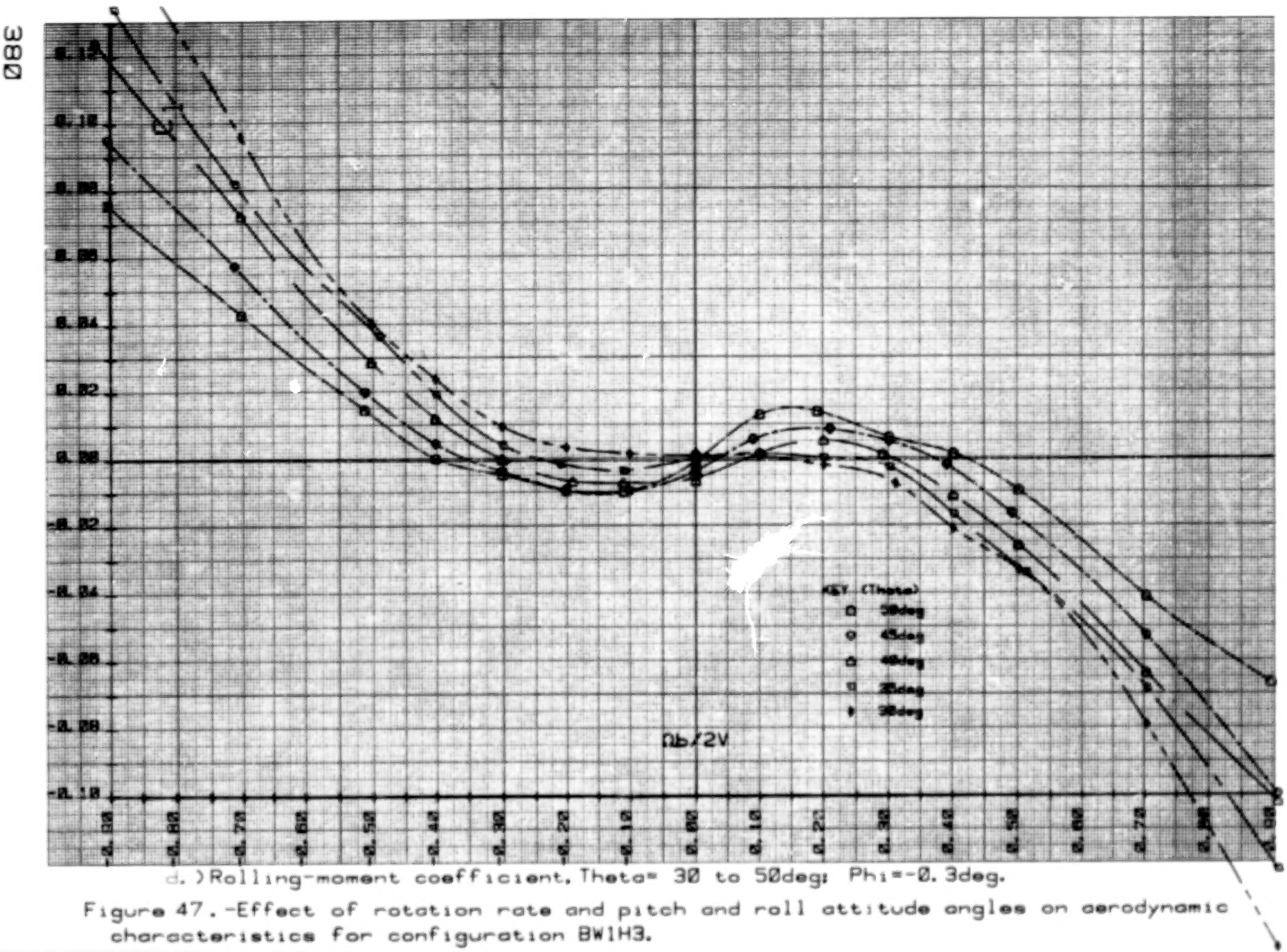
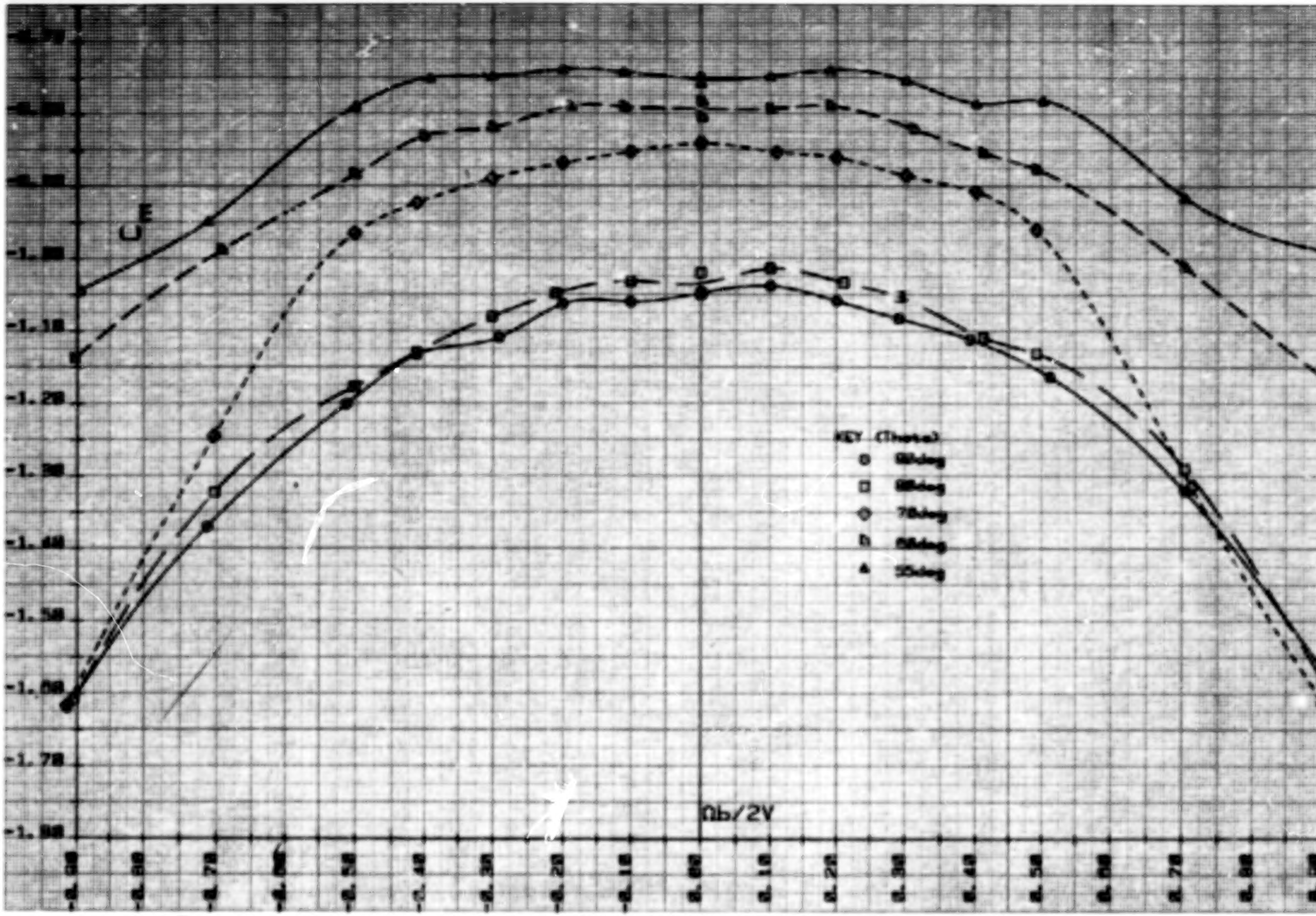


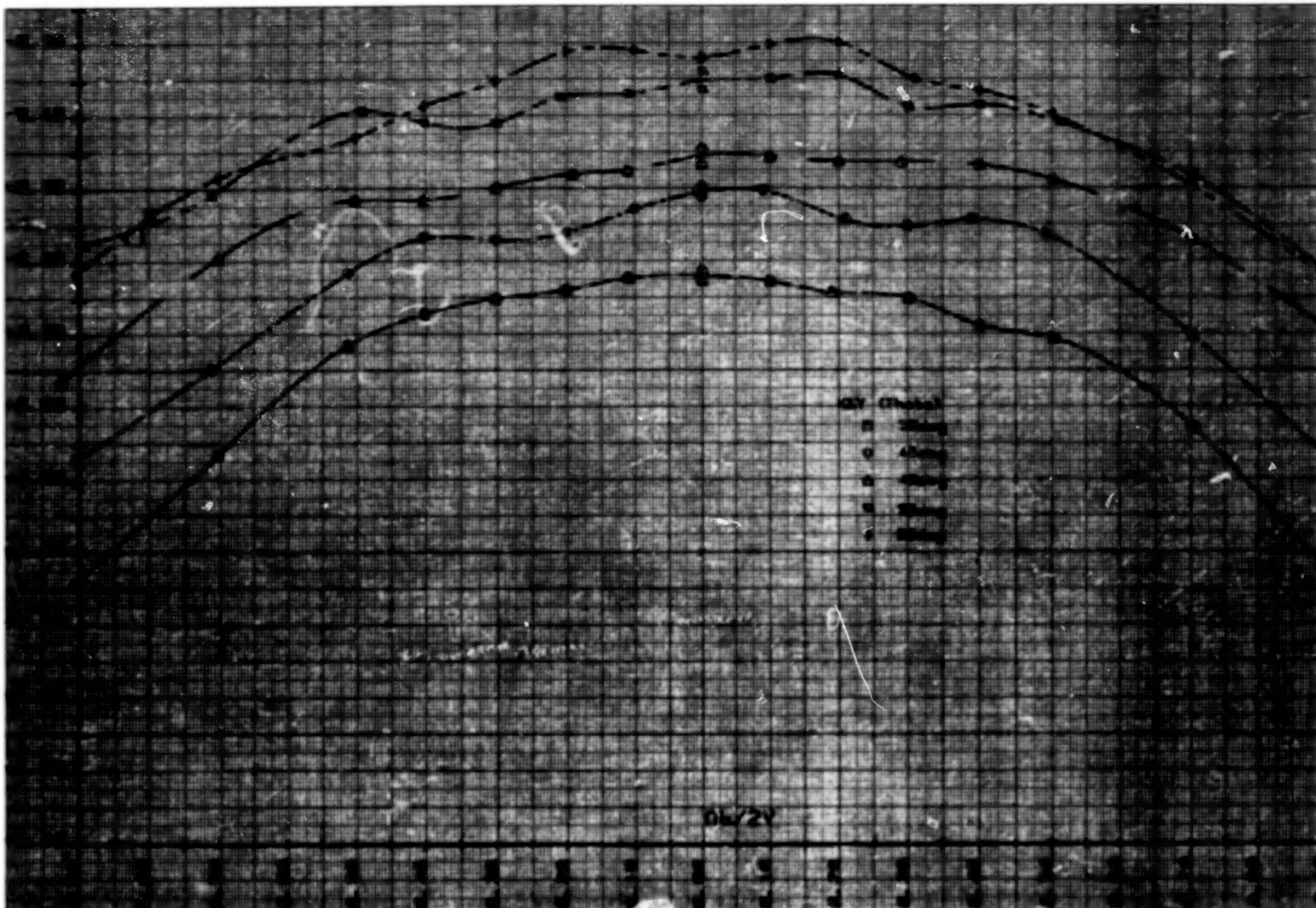
d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.3deg.

Figure 47.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3.



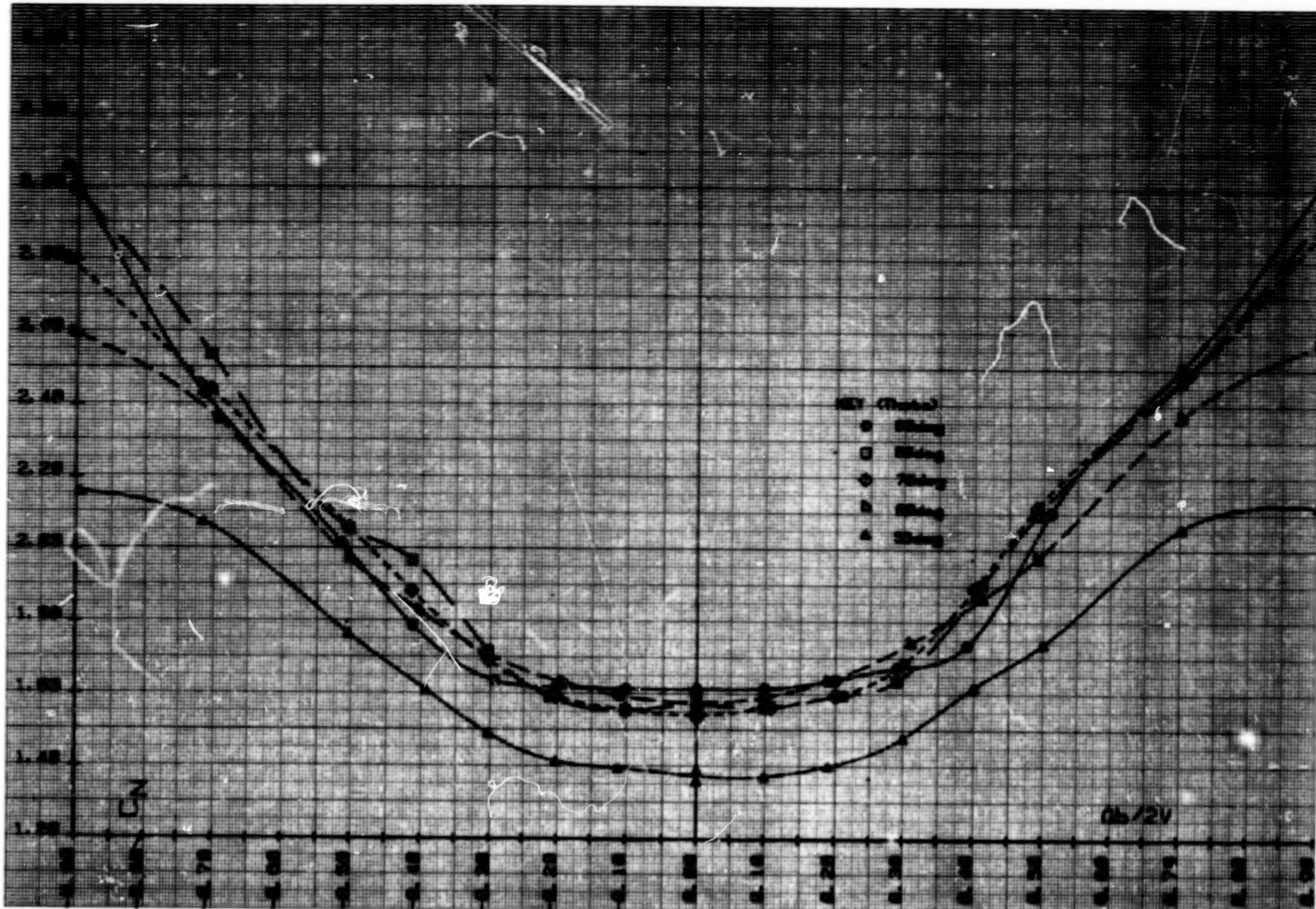
a.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi= 0.1deg.

Figure 47.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3.



f.) Pitching-moment coefficient. Theta= 30 to 50deg; Phi=-0.3deg.

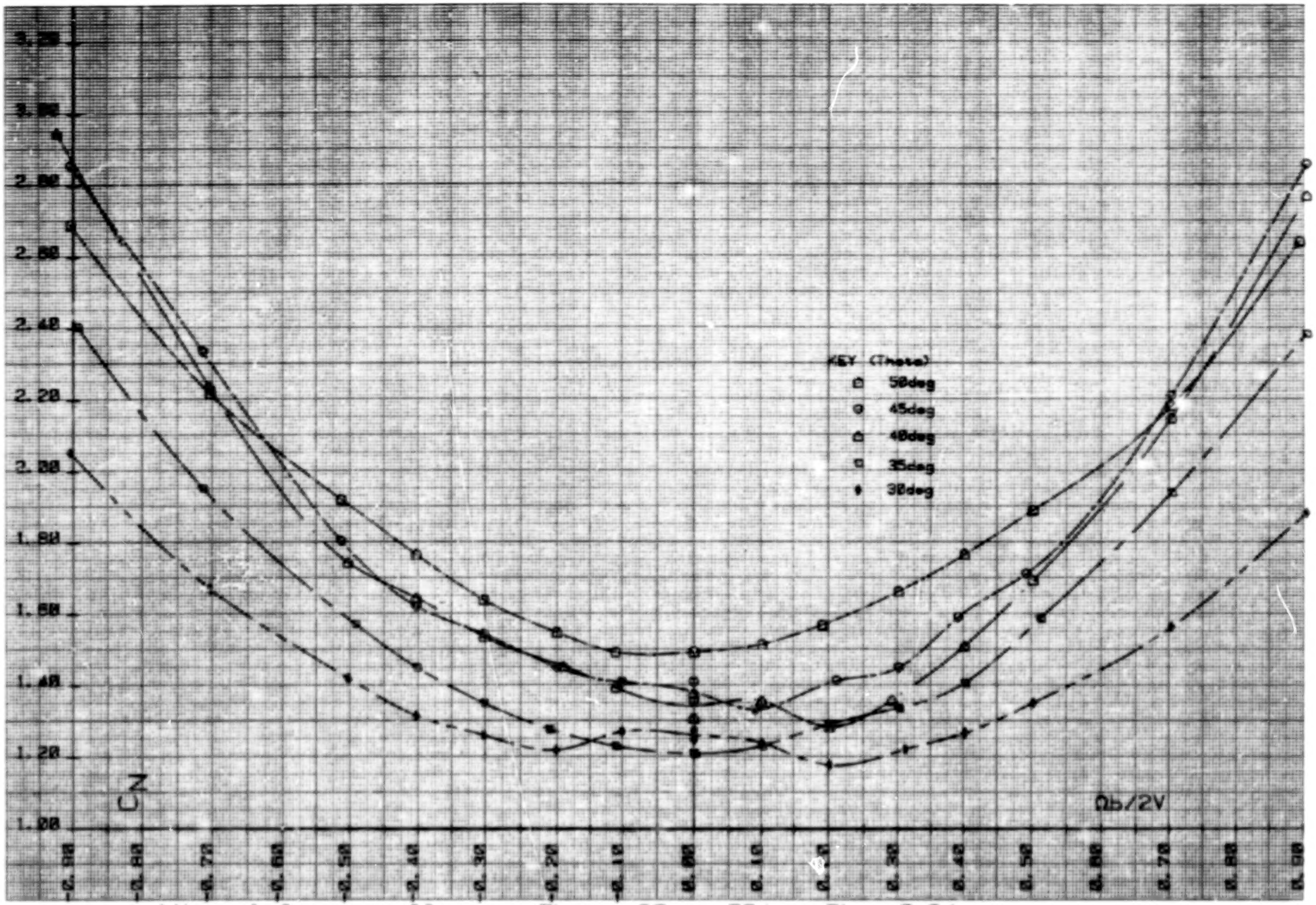
Figure 47. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3.



g.)Normal-force coefficient, Theta= 55 to 90deg; Phi= 0. 1deg.

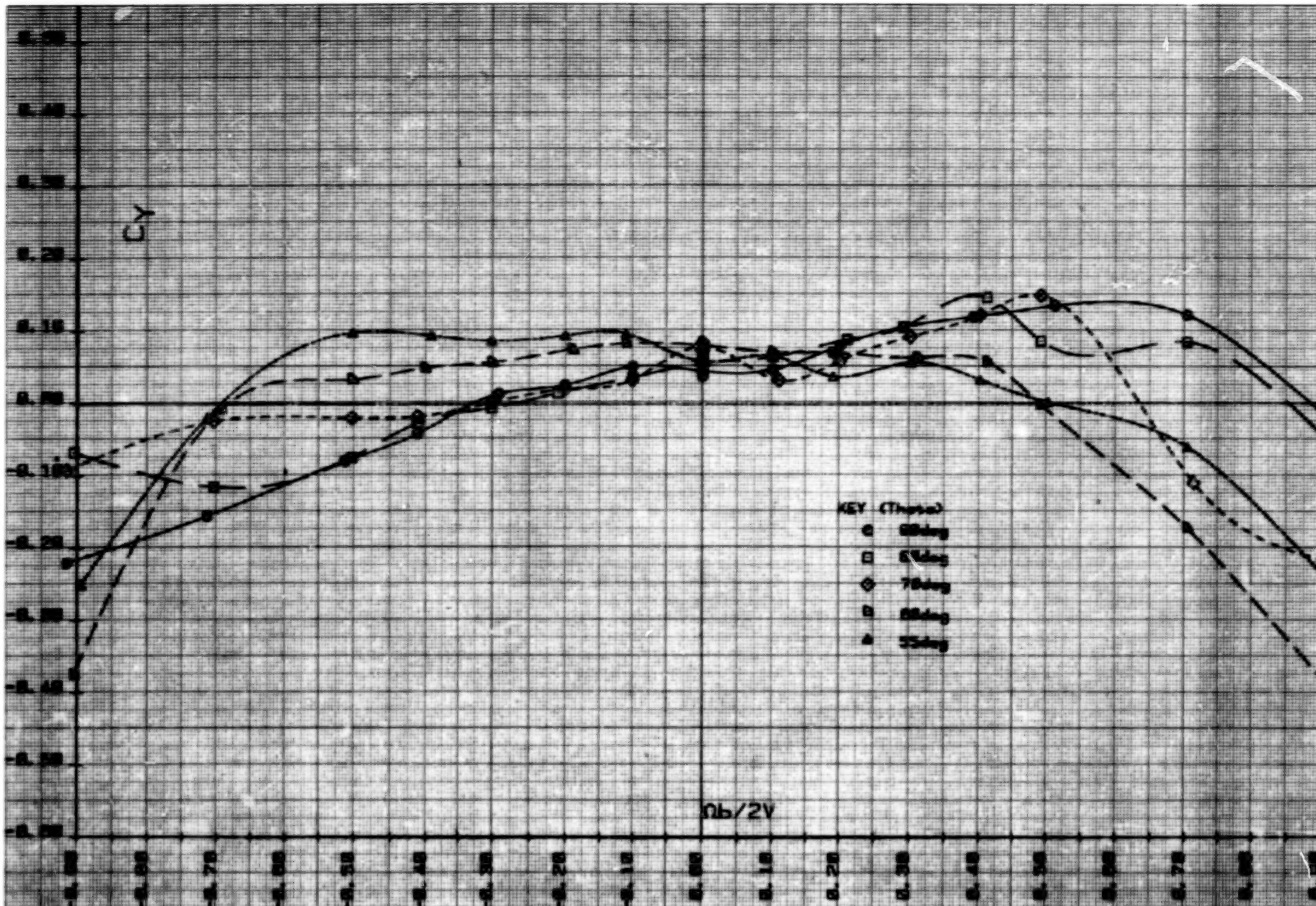
Figure 47. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3.

383



h.) Normal-force coefficient. Theta= 30 to 50deg; Phi=-0.3deg.

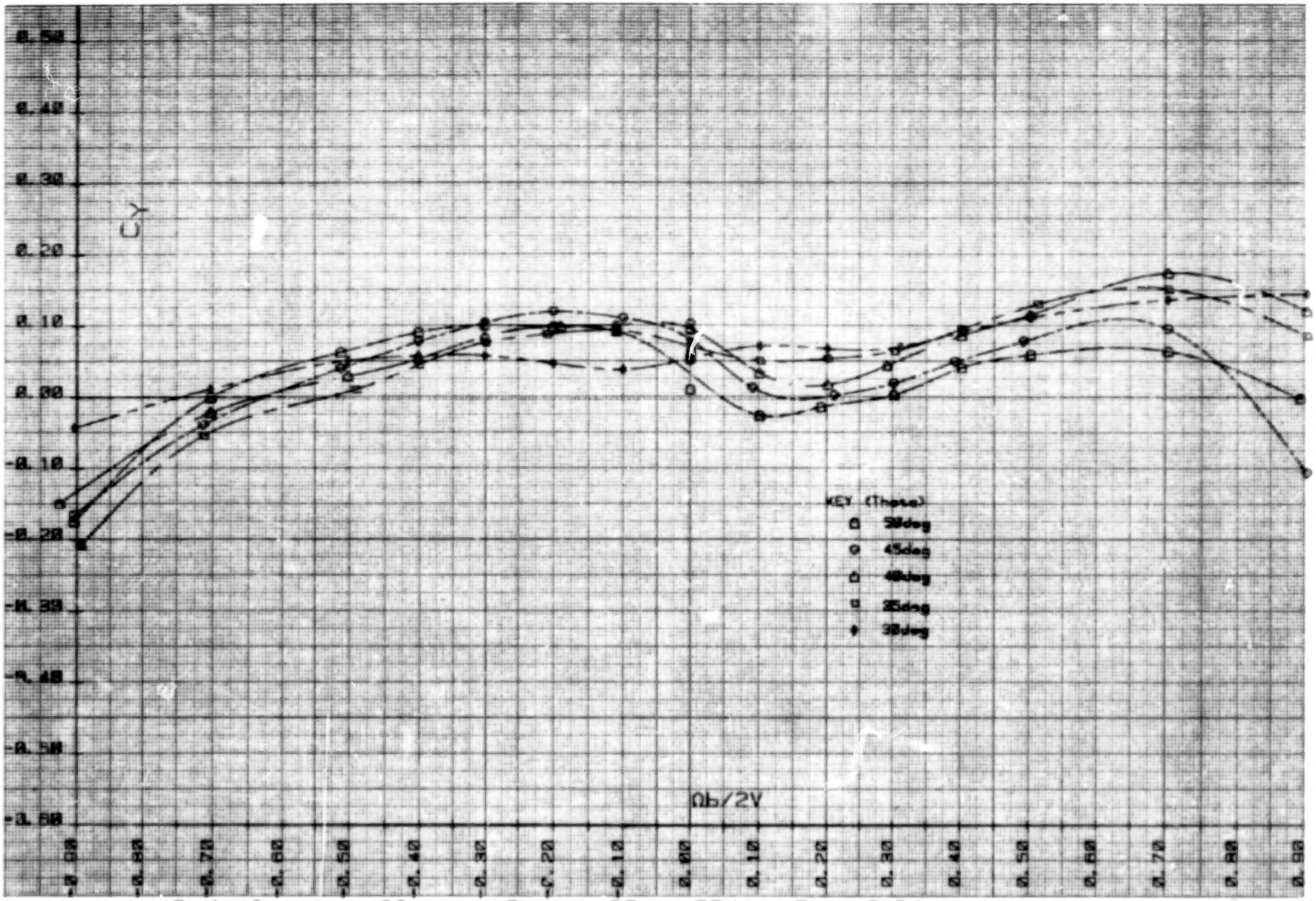
Figure 47.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3.



1.) Side-force coefficient, Theta= 55 to 90deg; Phi= 0.1deg.

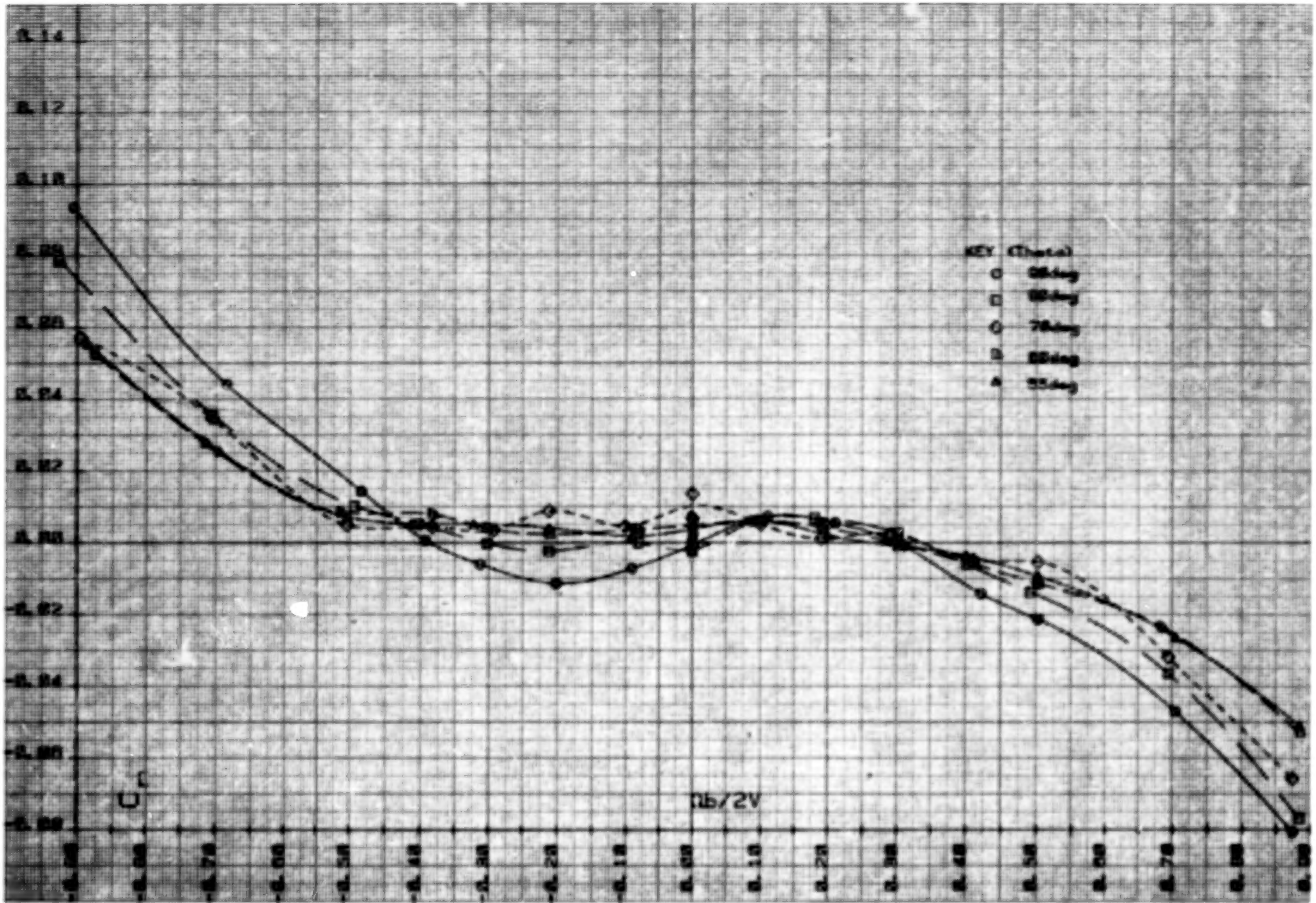
Figure 47.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3.

385



j.) Side-force coefficient, Theta= 30 to 50deg: Phi=-0.3deg.

Figure 47. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1H3.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 48.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1V.

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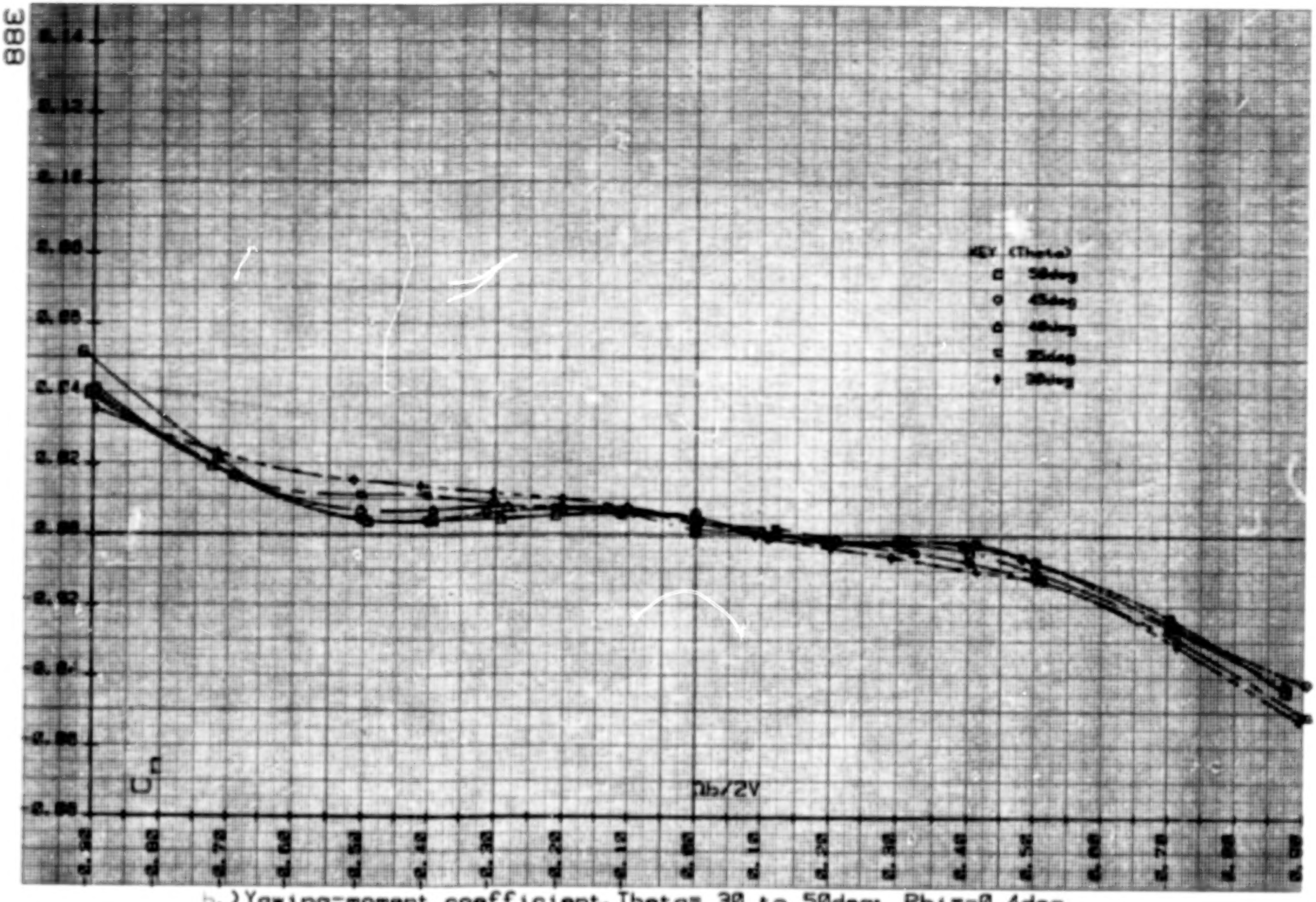
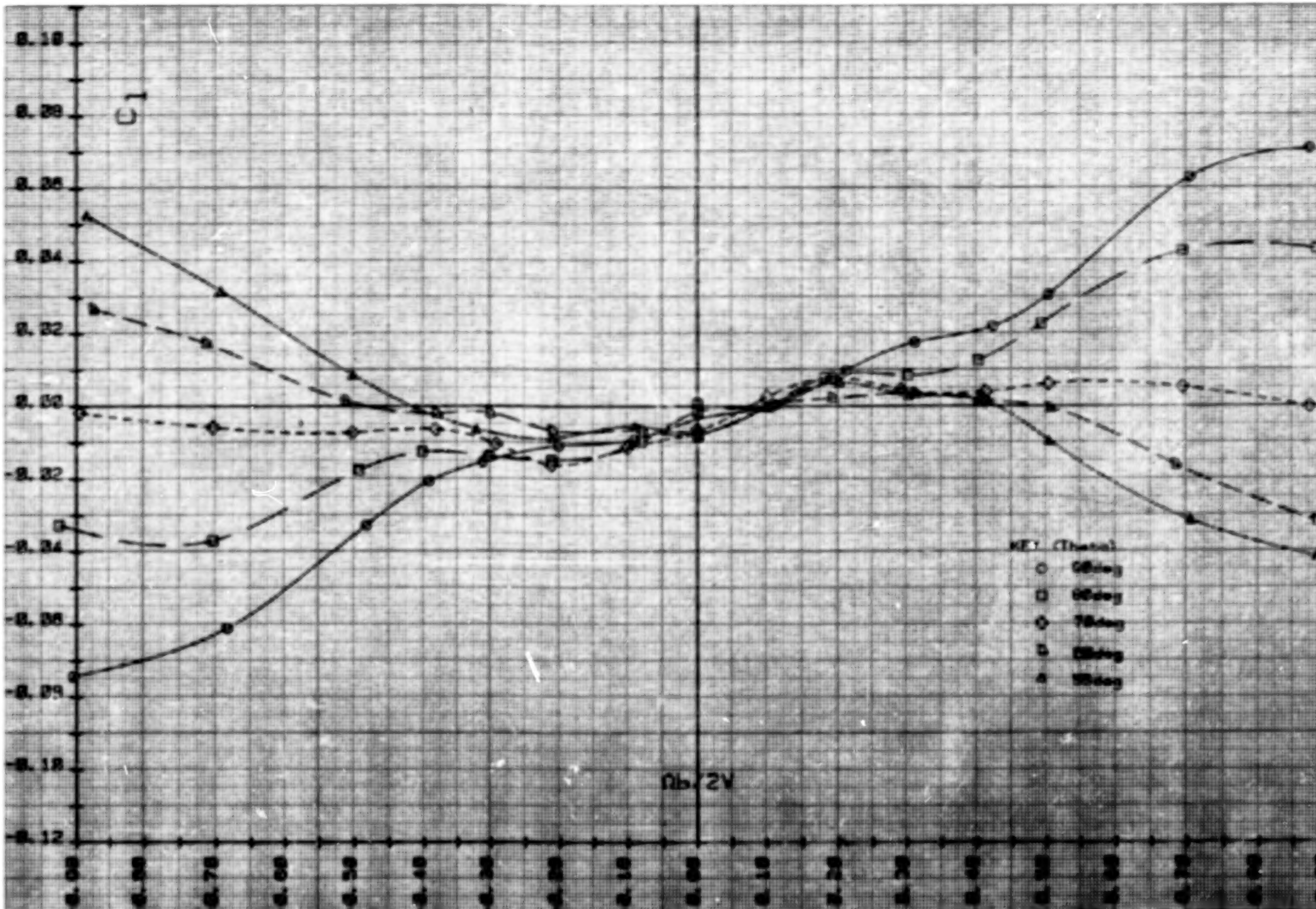


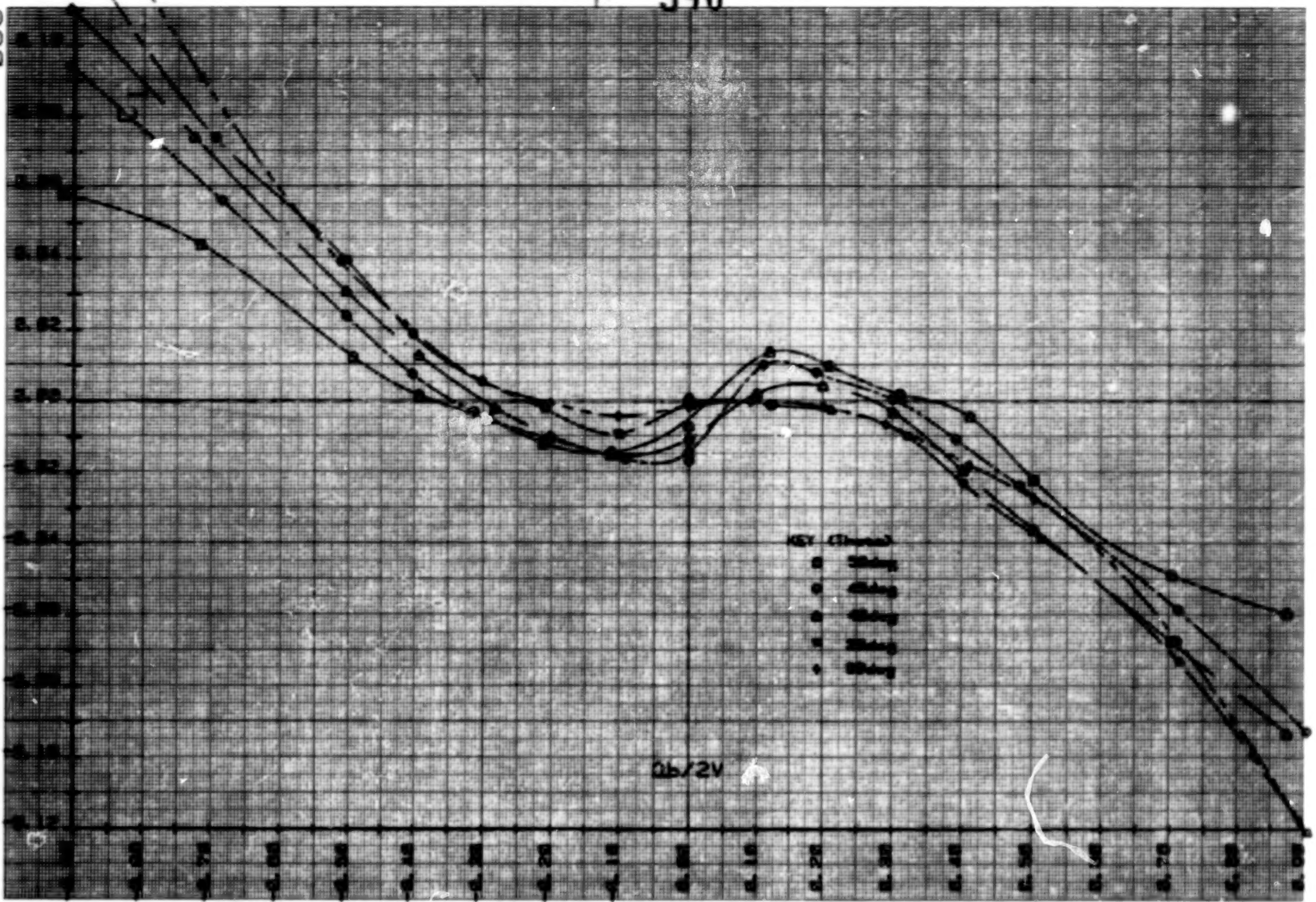
b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 48.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1V.



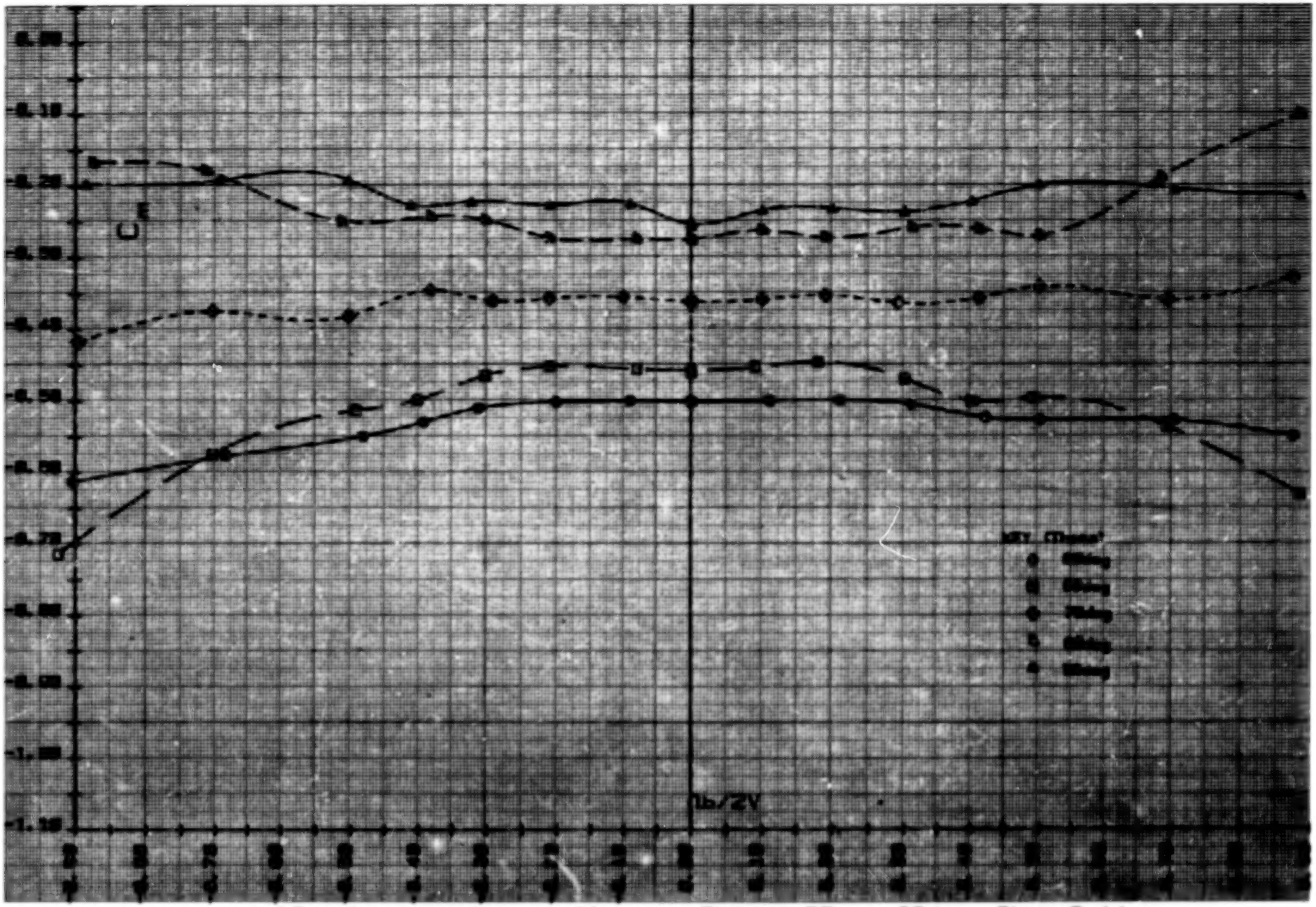
c.) Rolling-moment coefficient. Theta= 55 to 90deg; Phi=-0.5deg.

Figure 48.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1V.



d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 48. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1V.



e.)Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 48.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1V.

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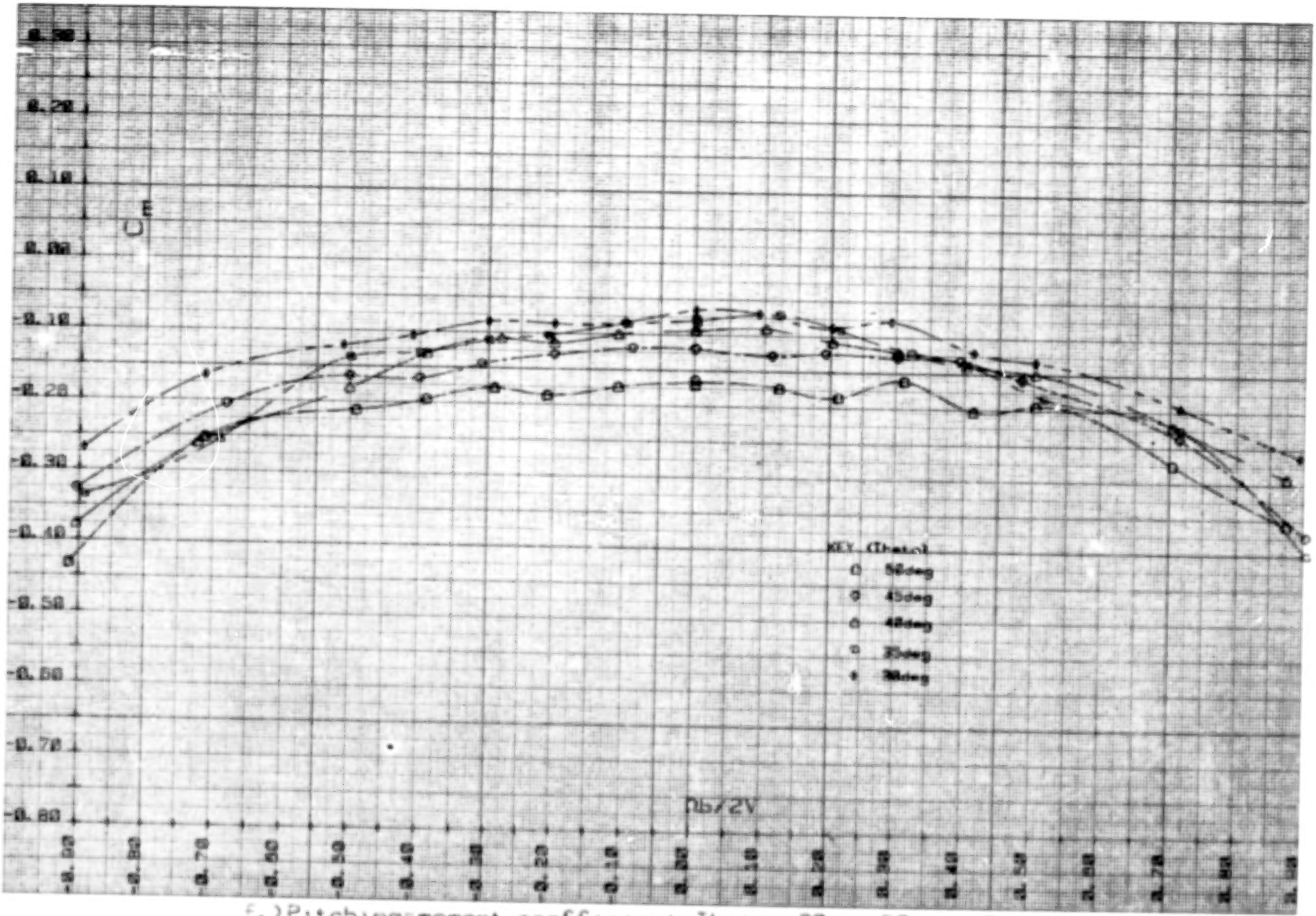
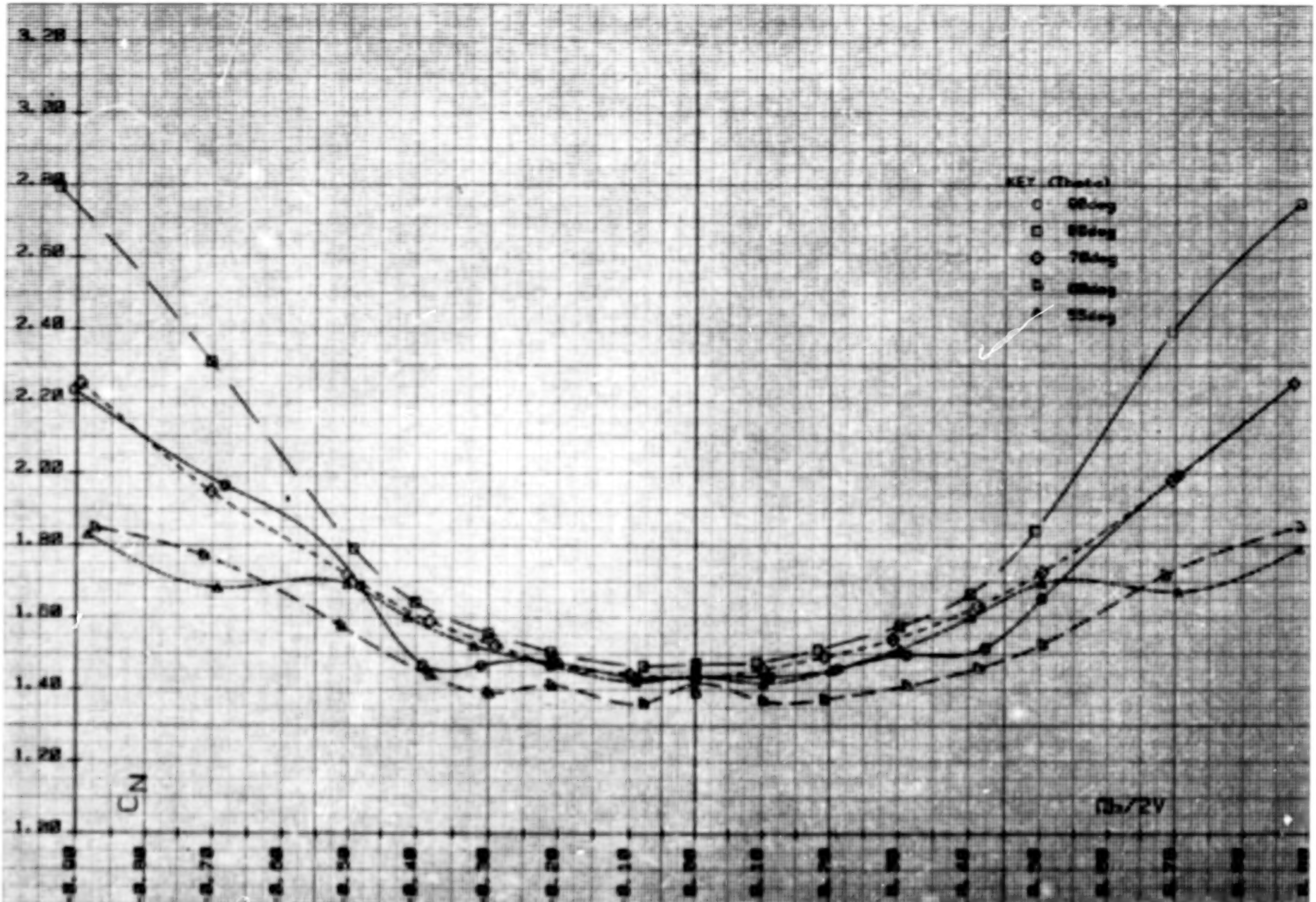


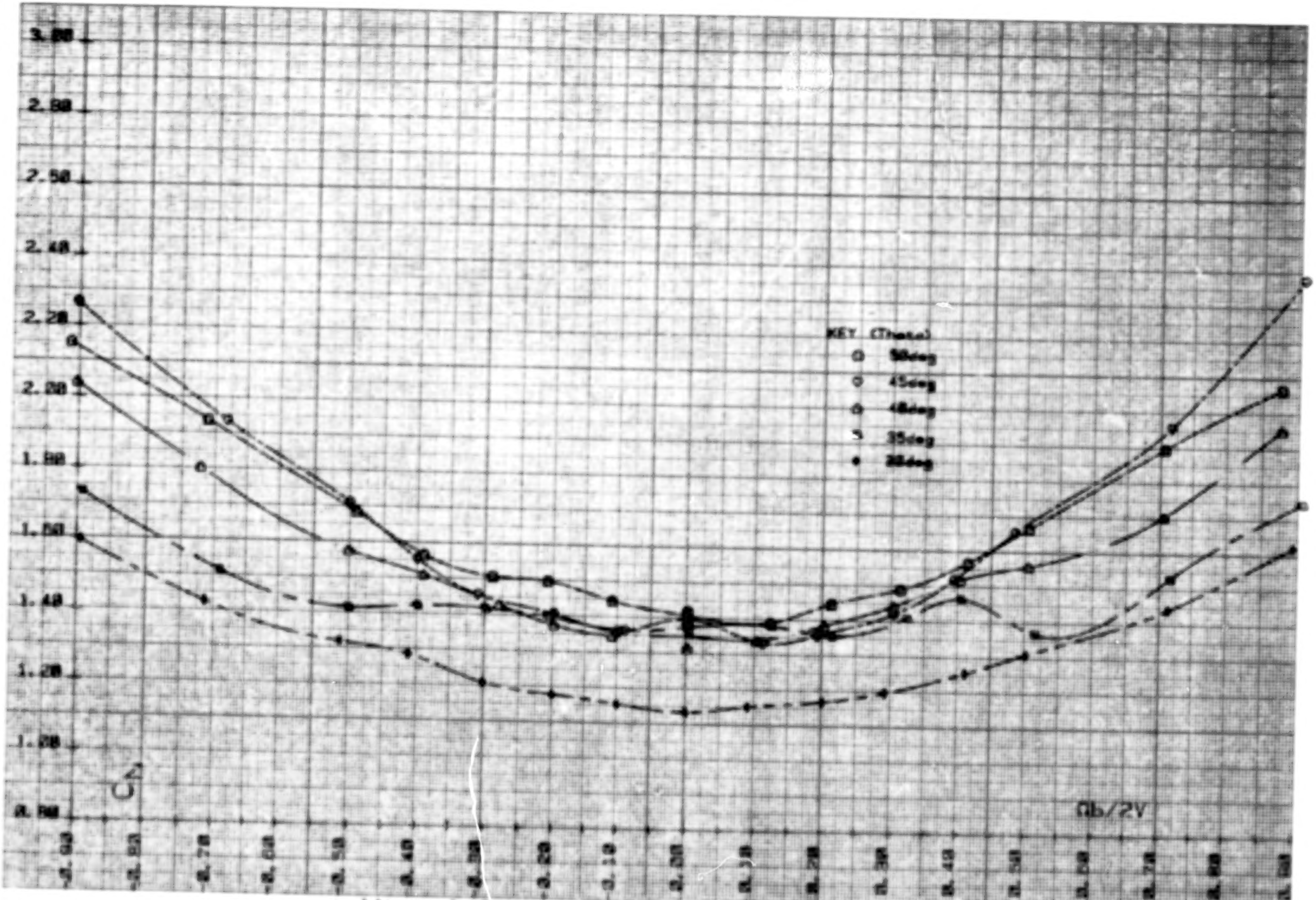
f.) Pitching-moment coefficient. Theta= 30 to 50deg; Phi=-0.4deg.

Figure 48.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1V.



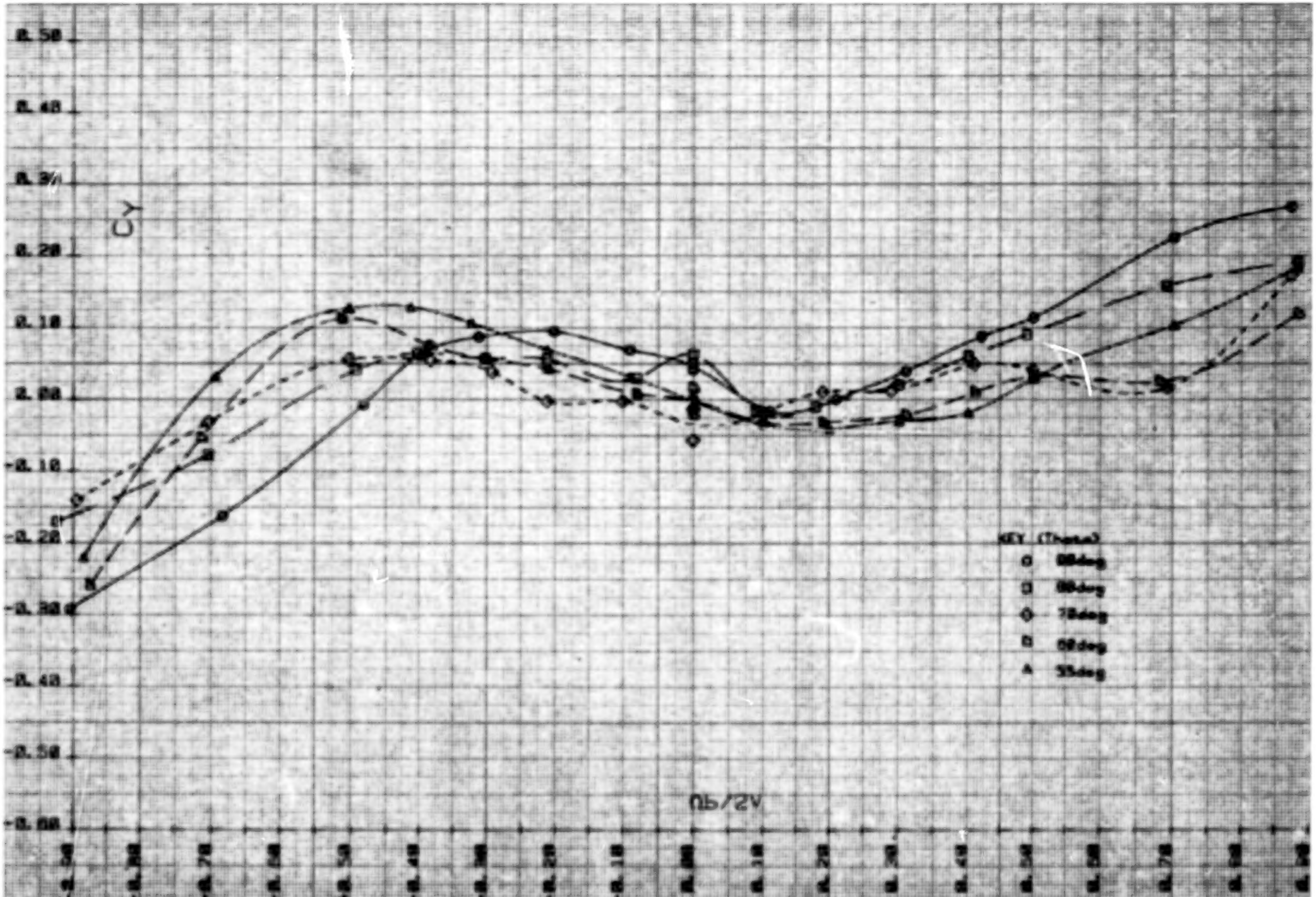
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 48.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1V.



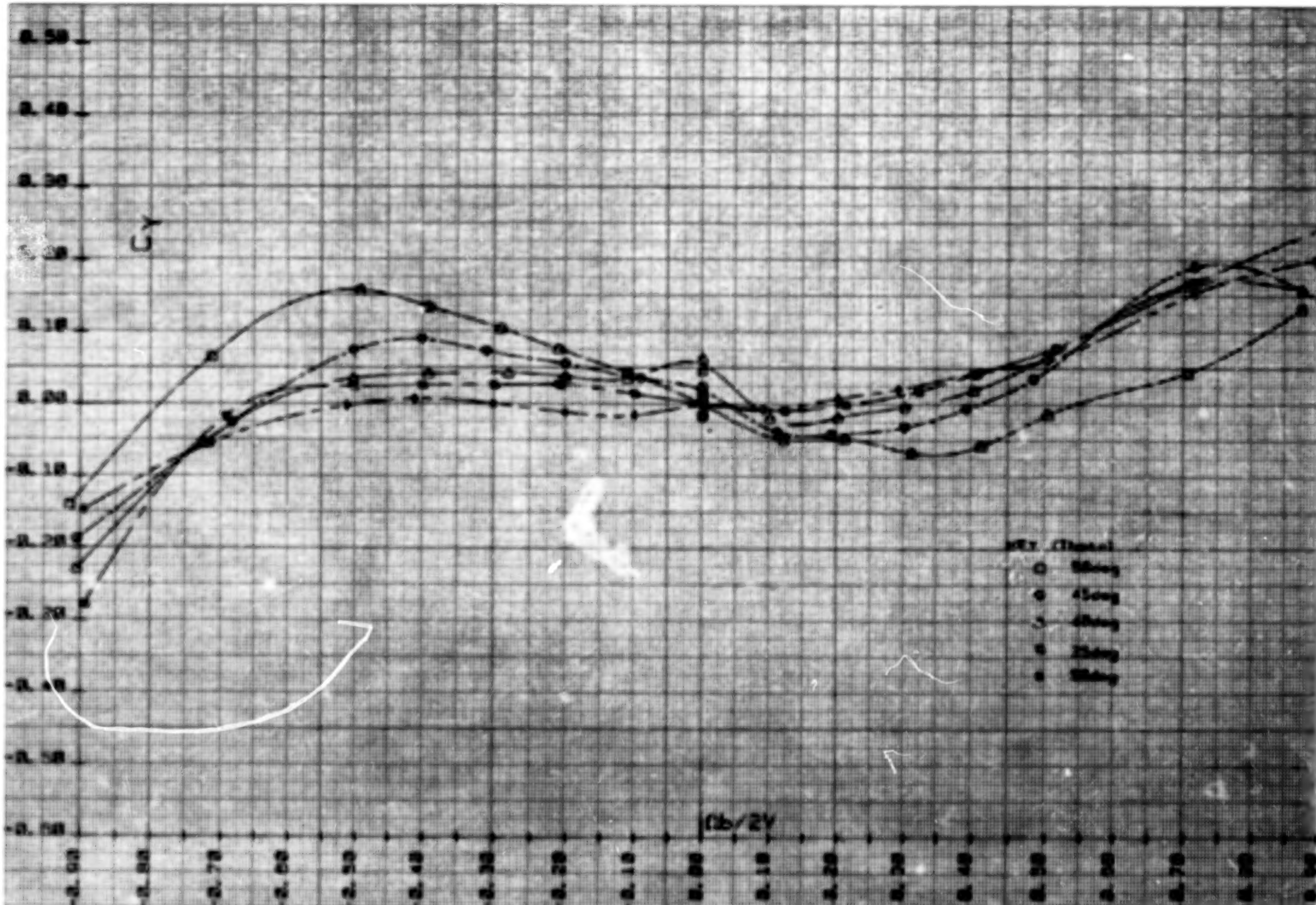
h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 48.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1V.



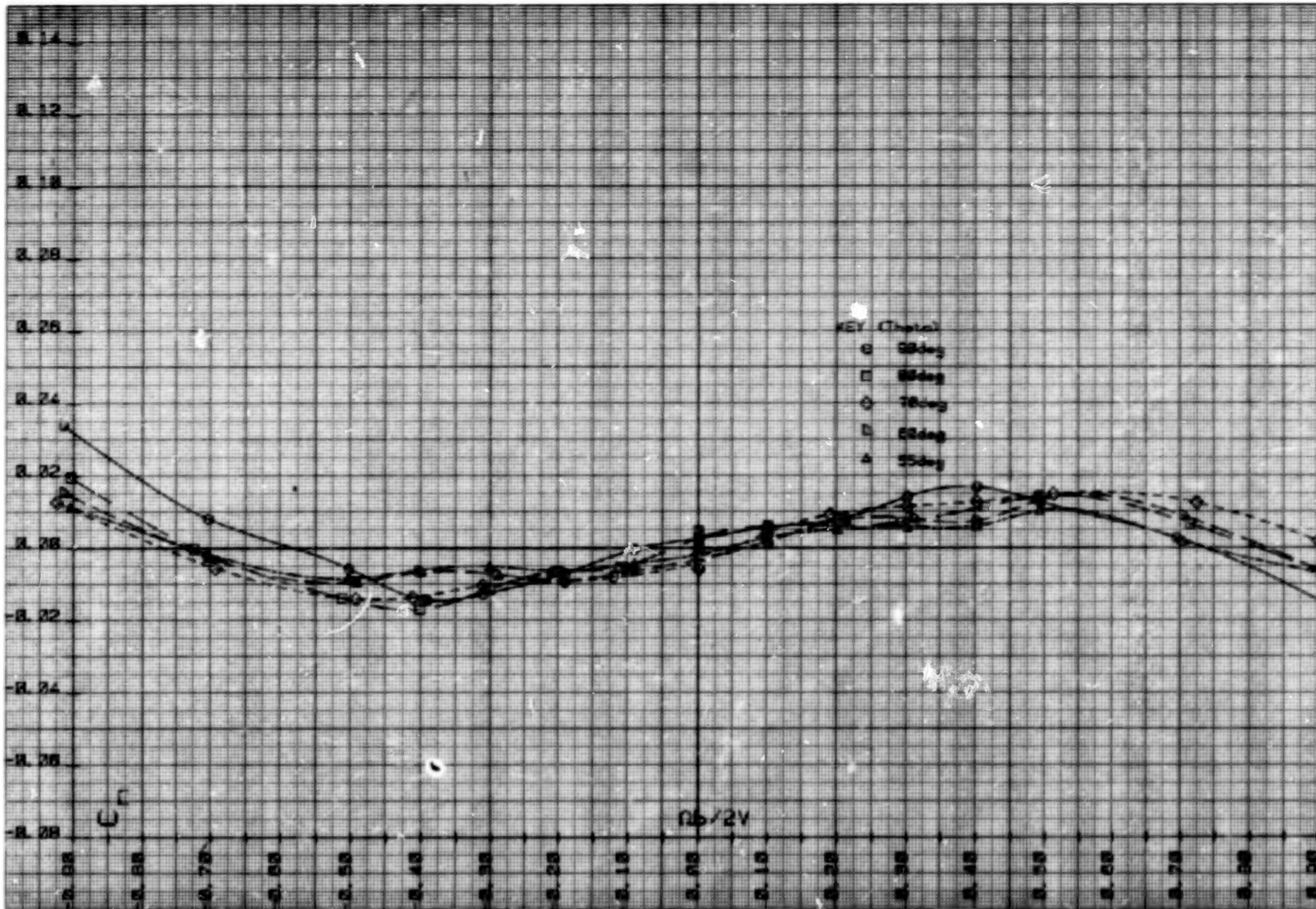
i.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.5deg.

Figure 48.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1V.



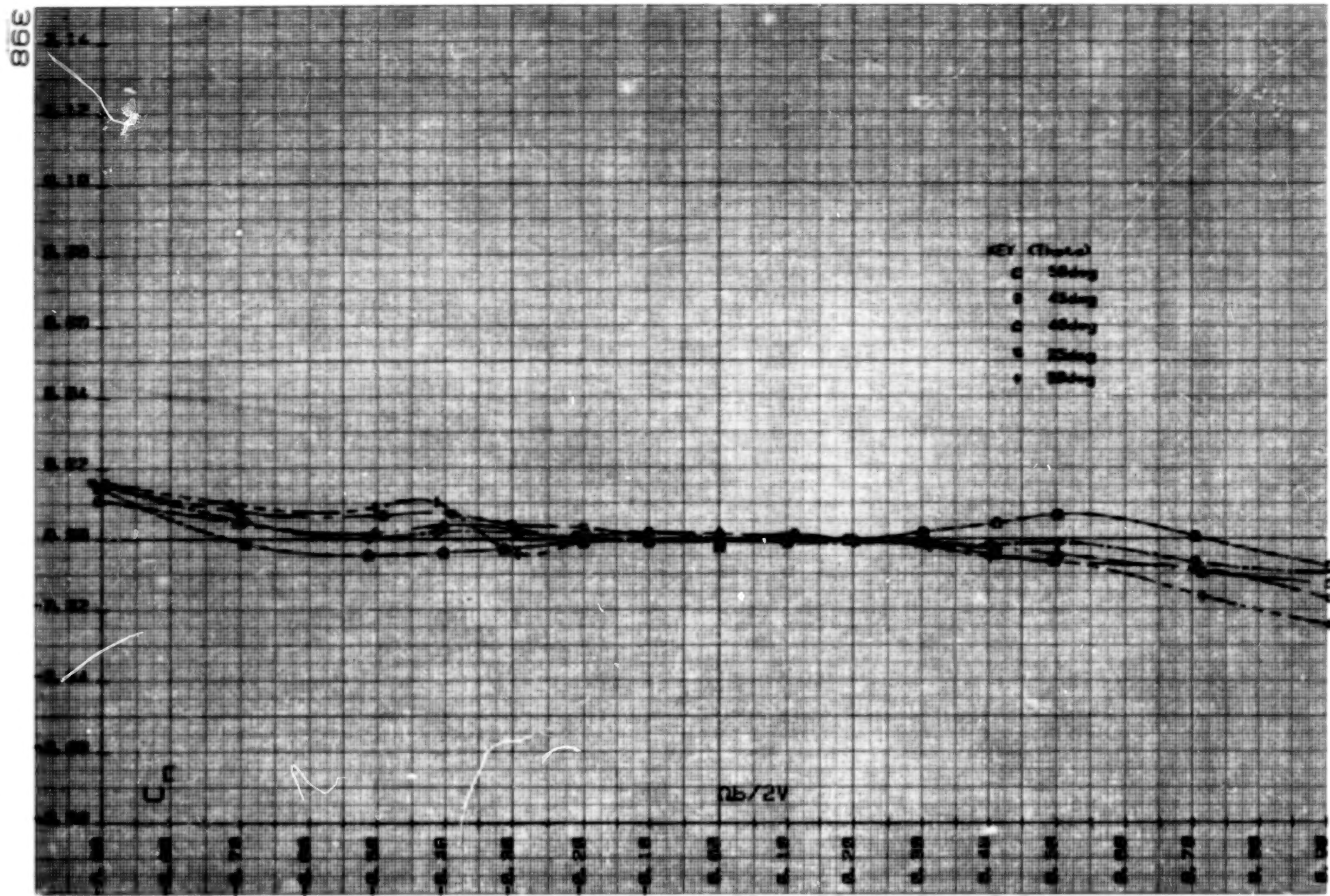
(j) Side-force coefficient. Theta= 30 to 50deg; Phi=-0.4deg.

Figure 48.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1V.



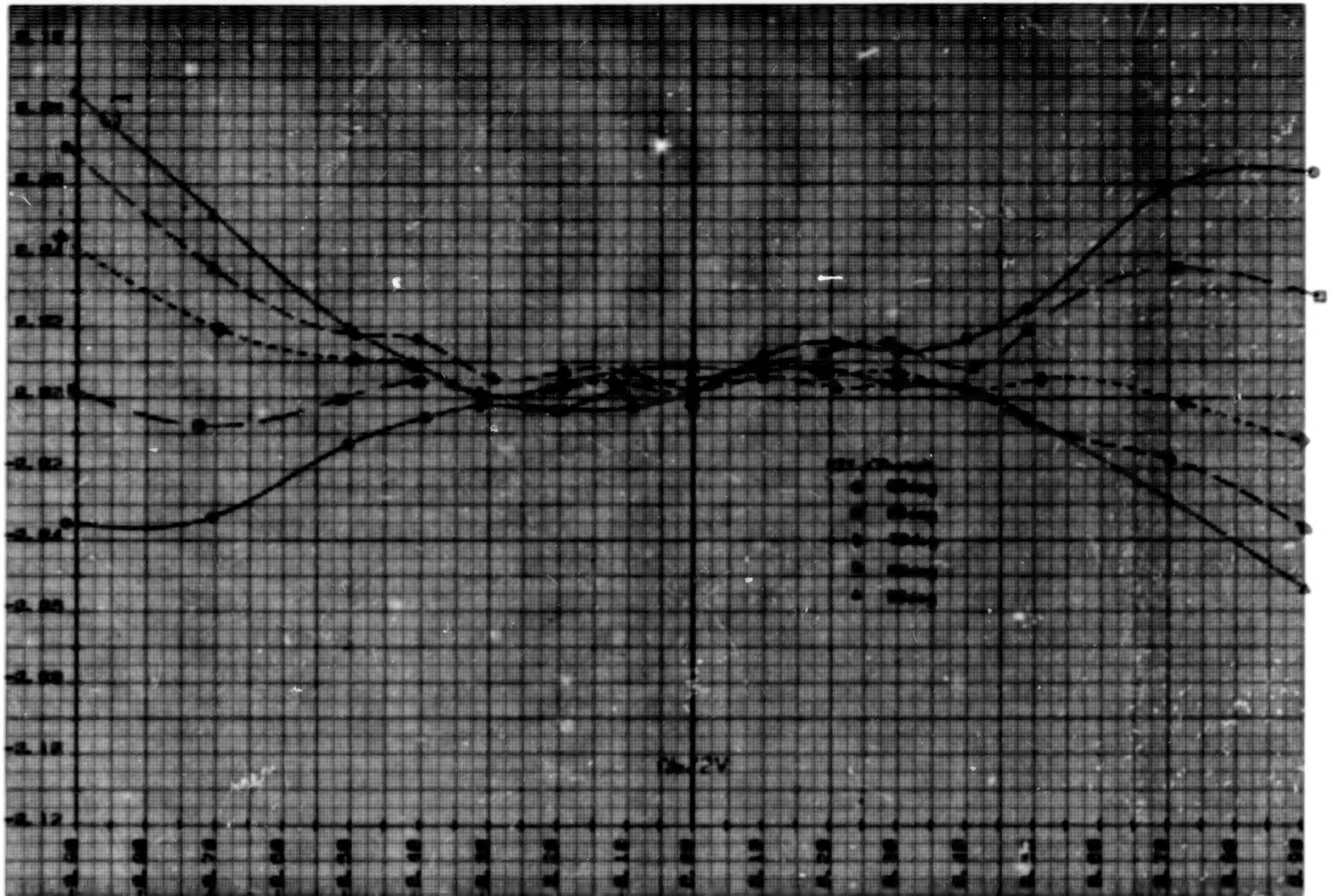
a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.8deg.

Figure 49.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1.



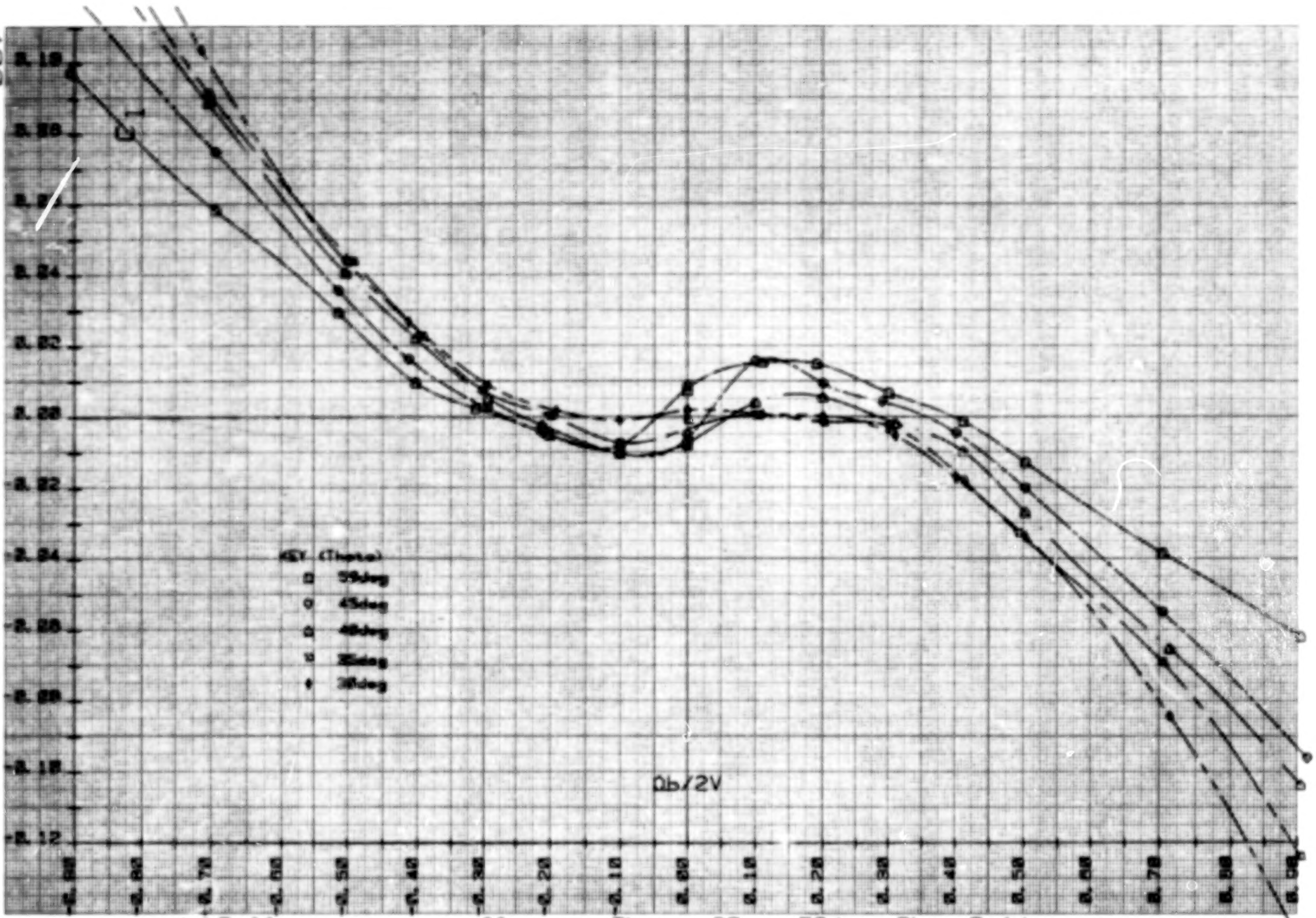
b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.8deg.

Figure 49. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1.



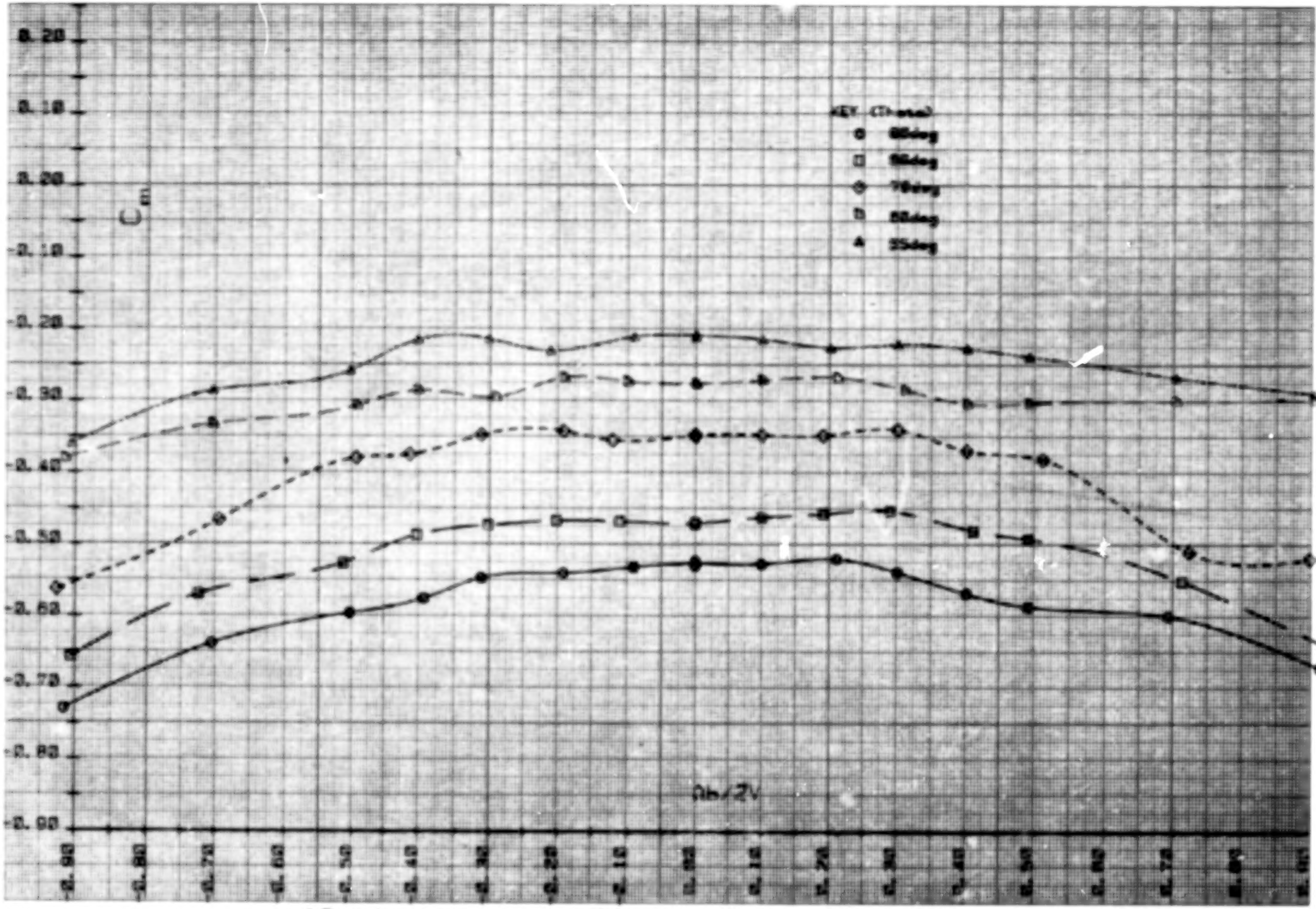
c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.6deg.

Figure 49. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1.



d.) Rolling-moment coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

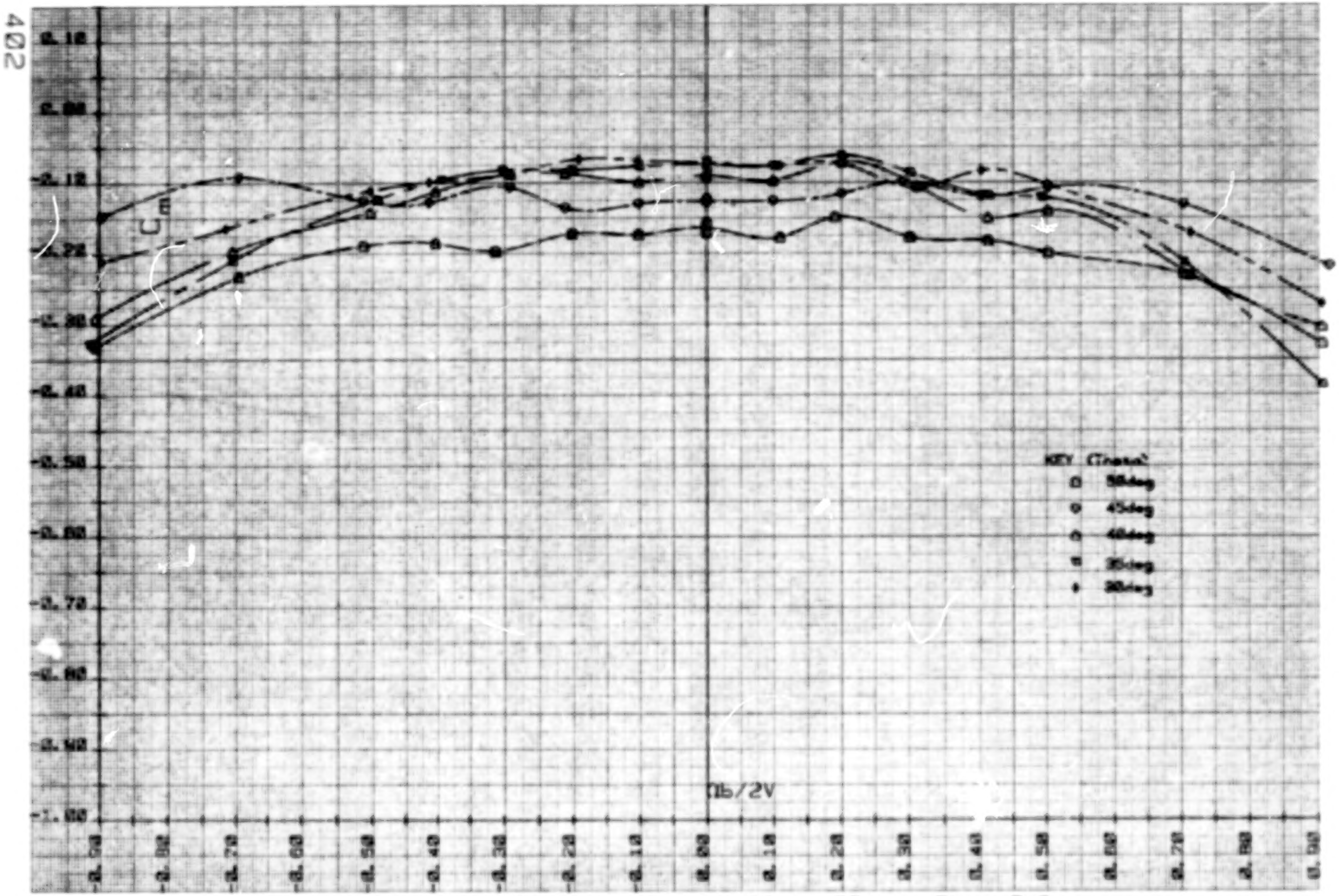
Figure 49. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1.



a.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.6deg.

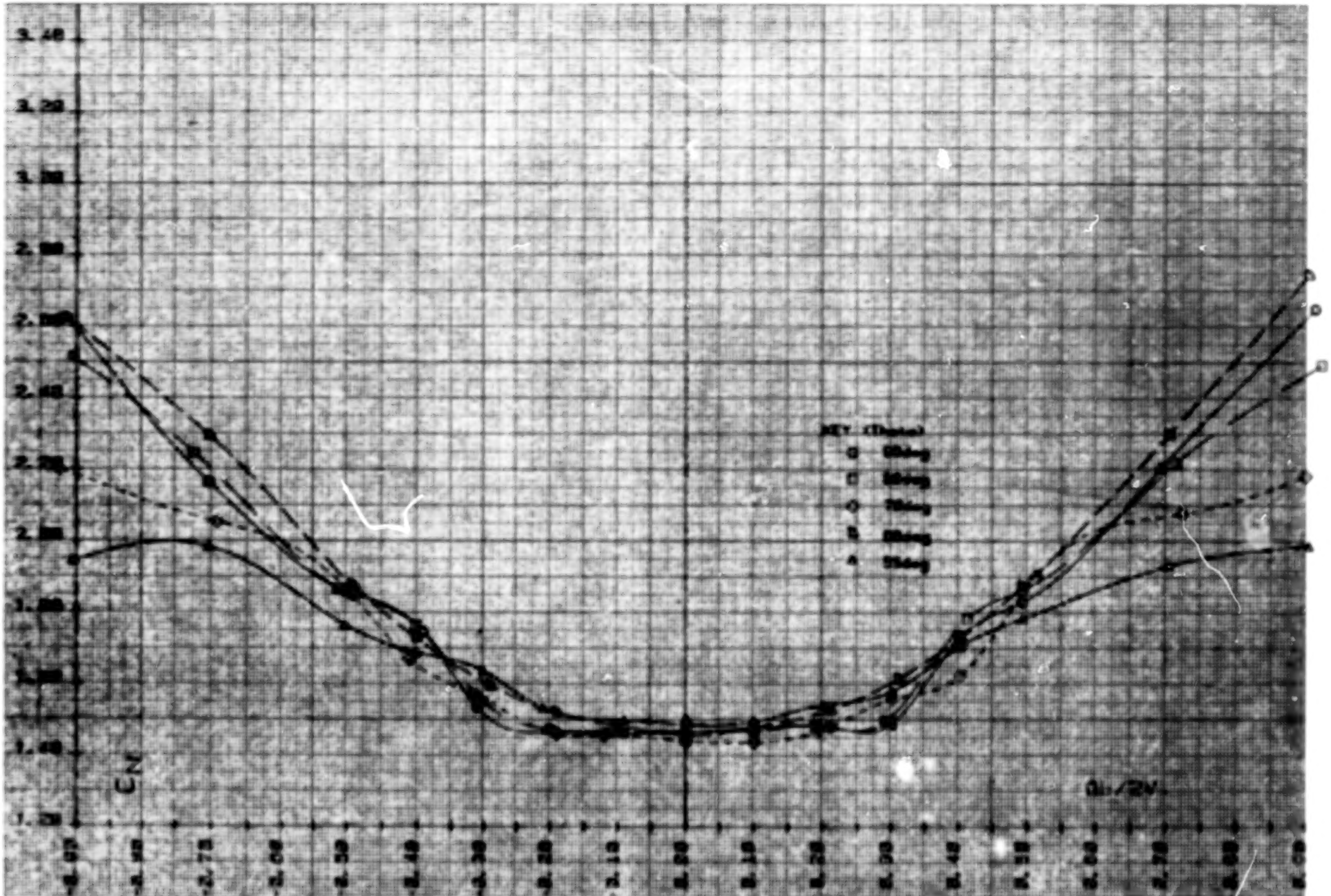
Figure 49 .-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1.

401



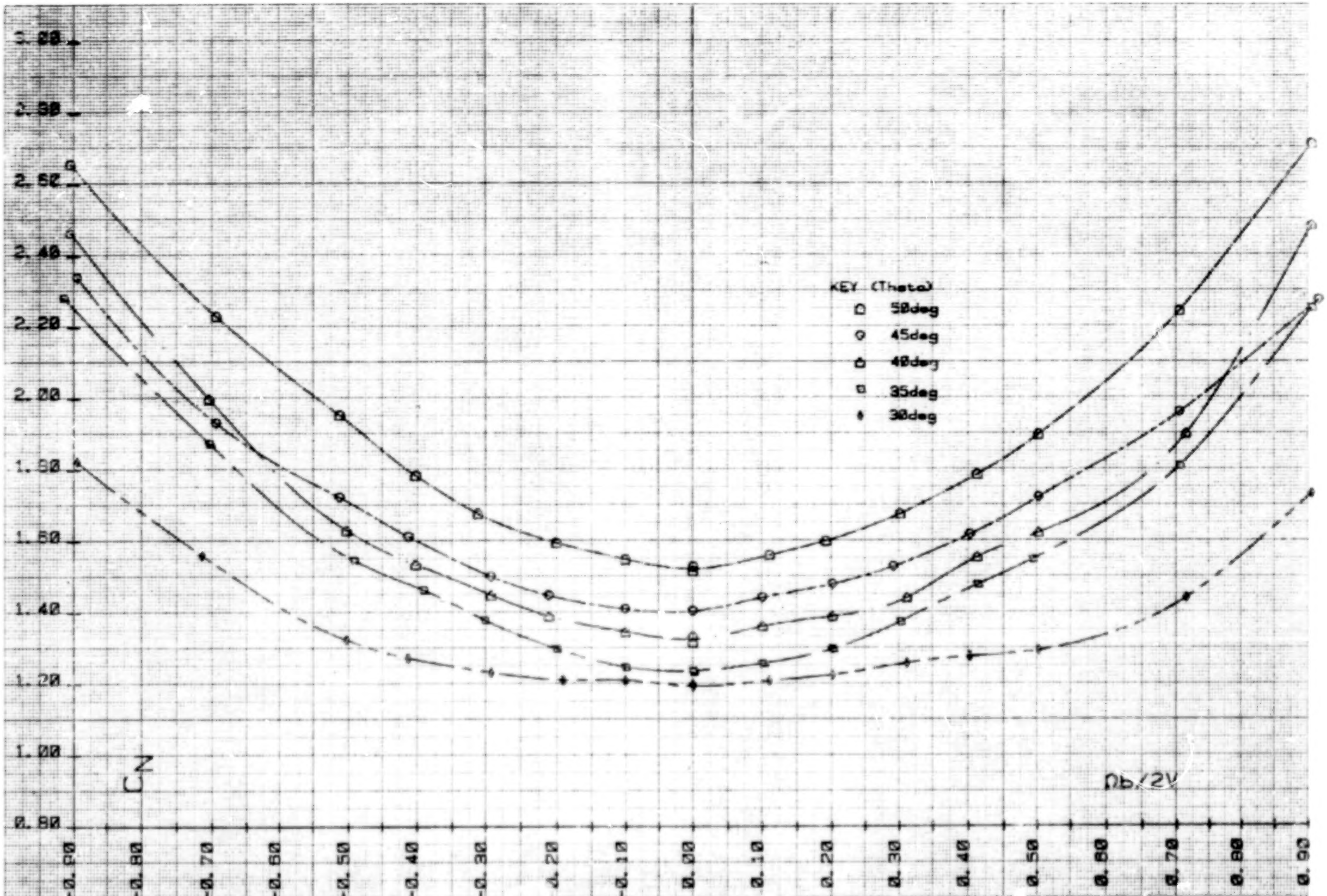
f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.0deg.

Figure 49. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1.



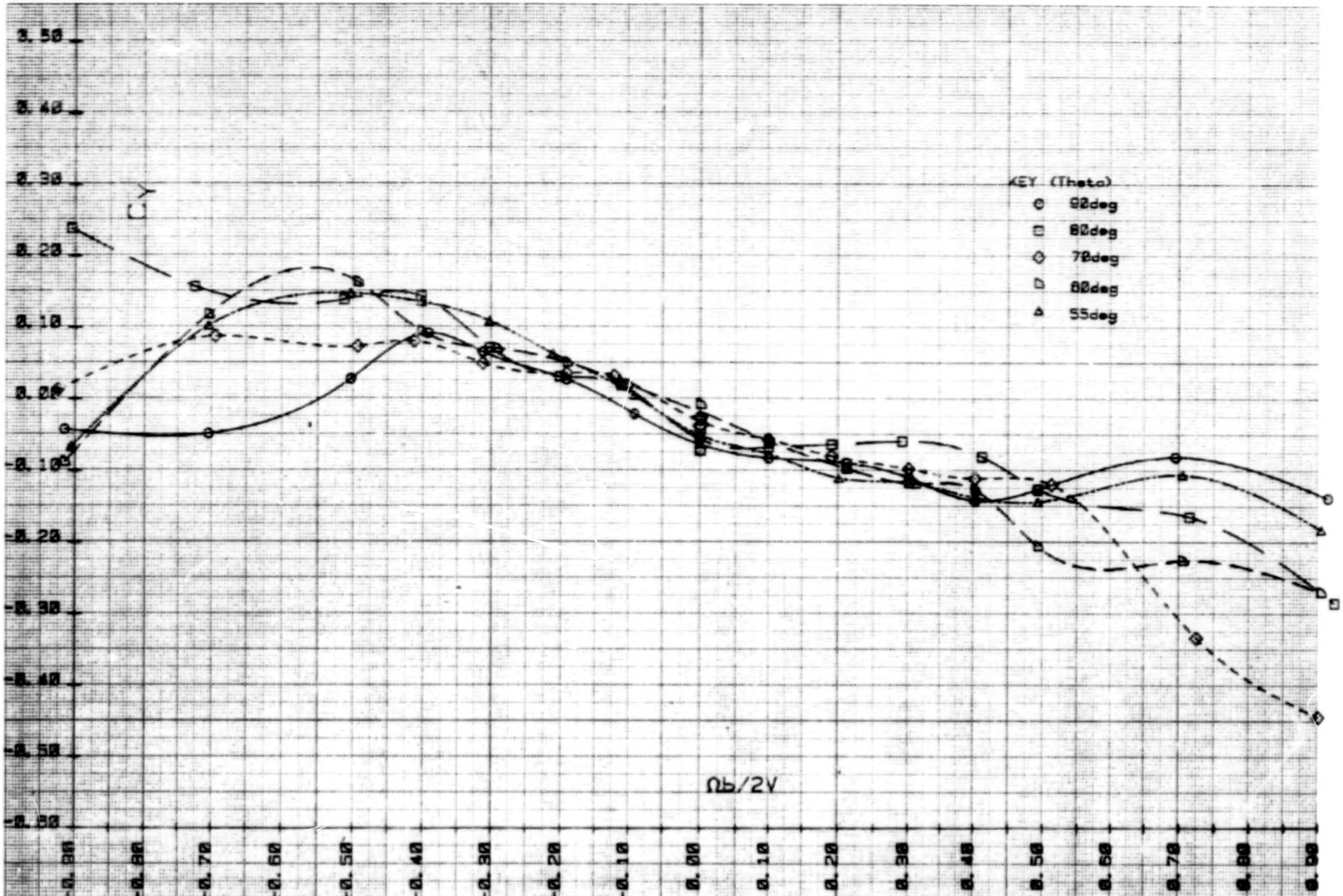
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.0deg.

Figure 49.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1.



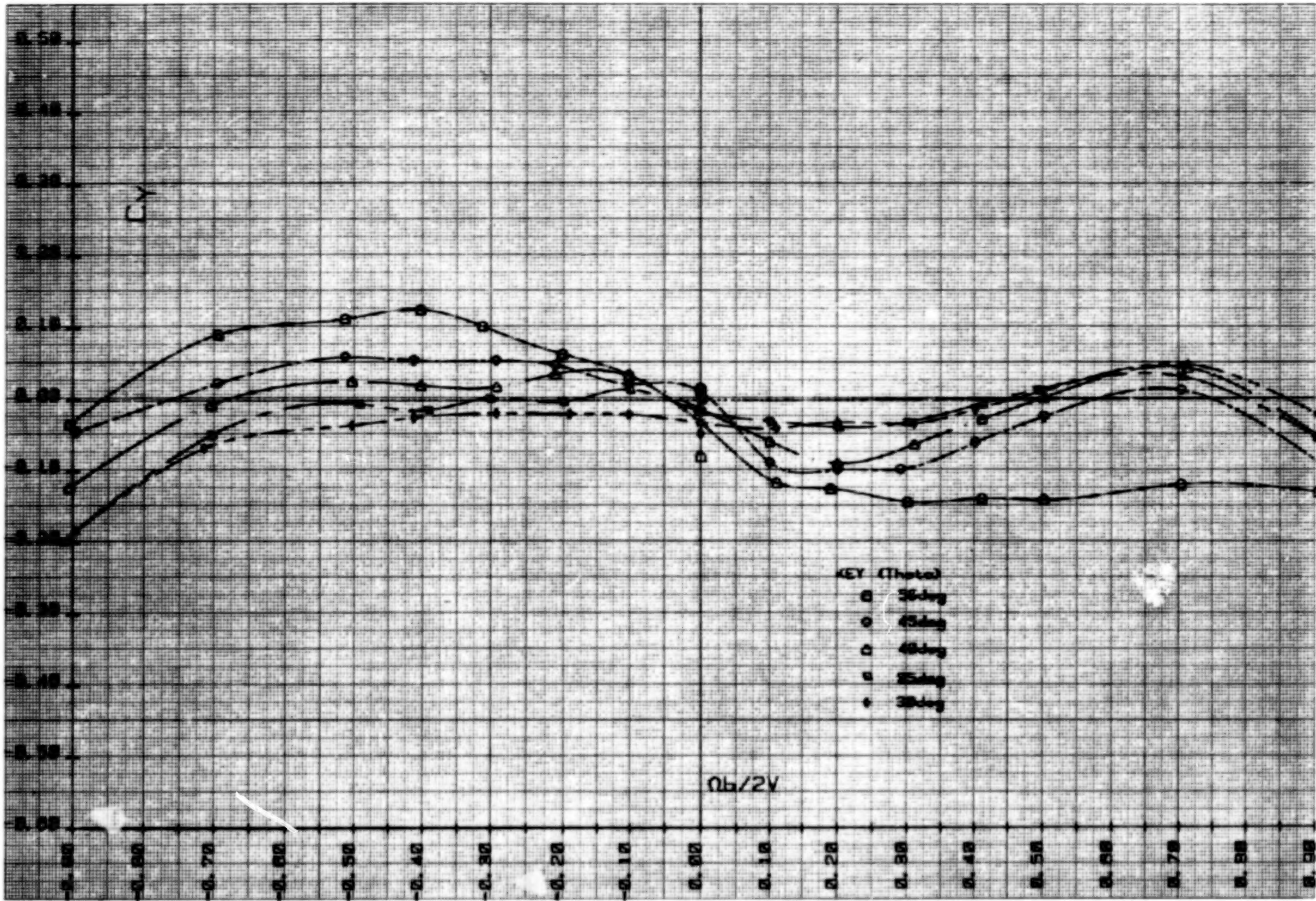
h.) Normal-force coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 49. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1.



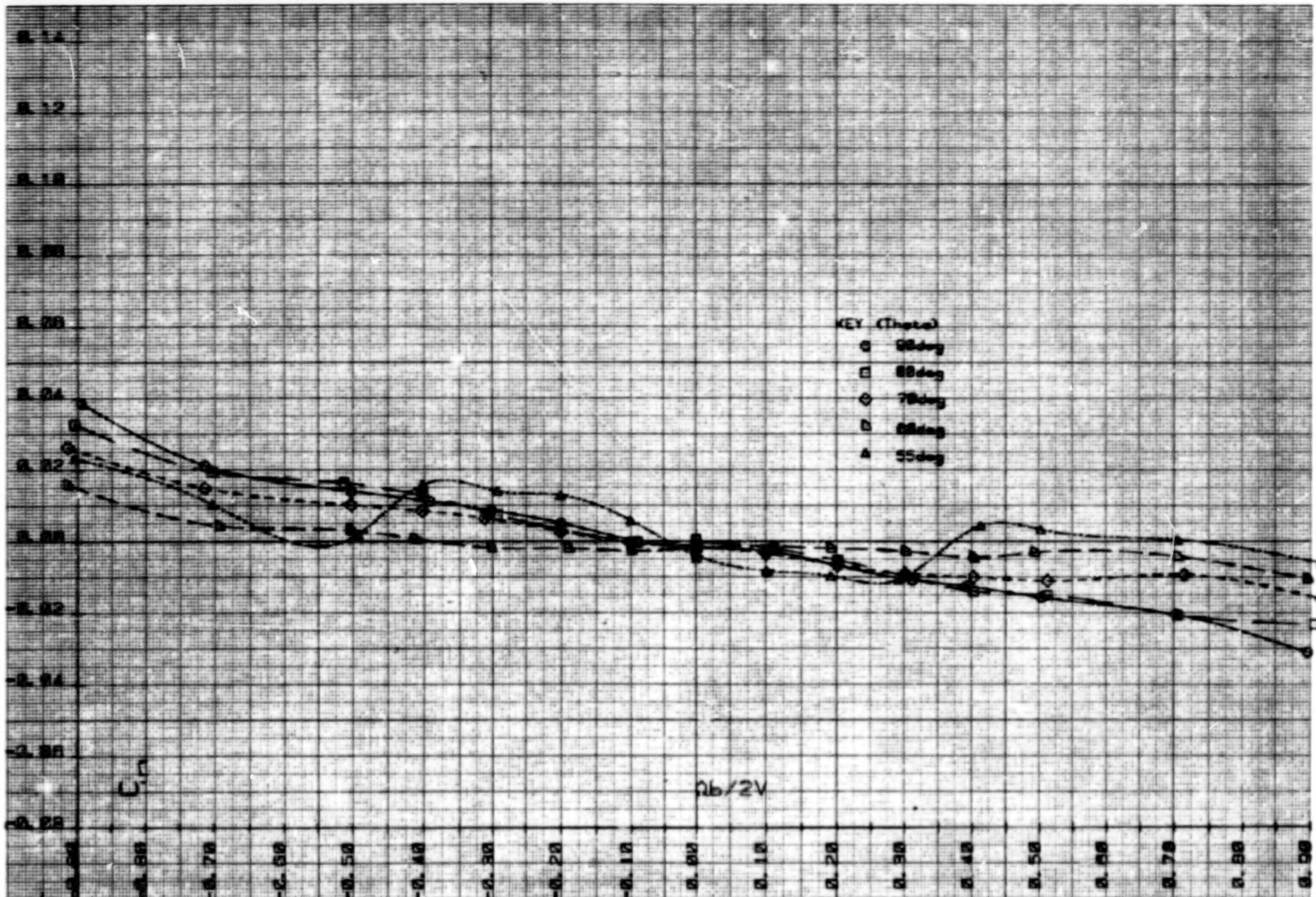
1.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.8deg.

Figure 49. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1.



j.) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.8deg.

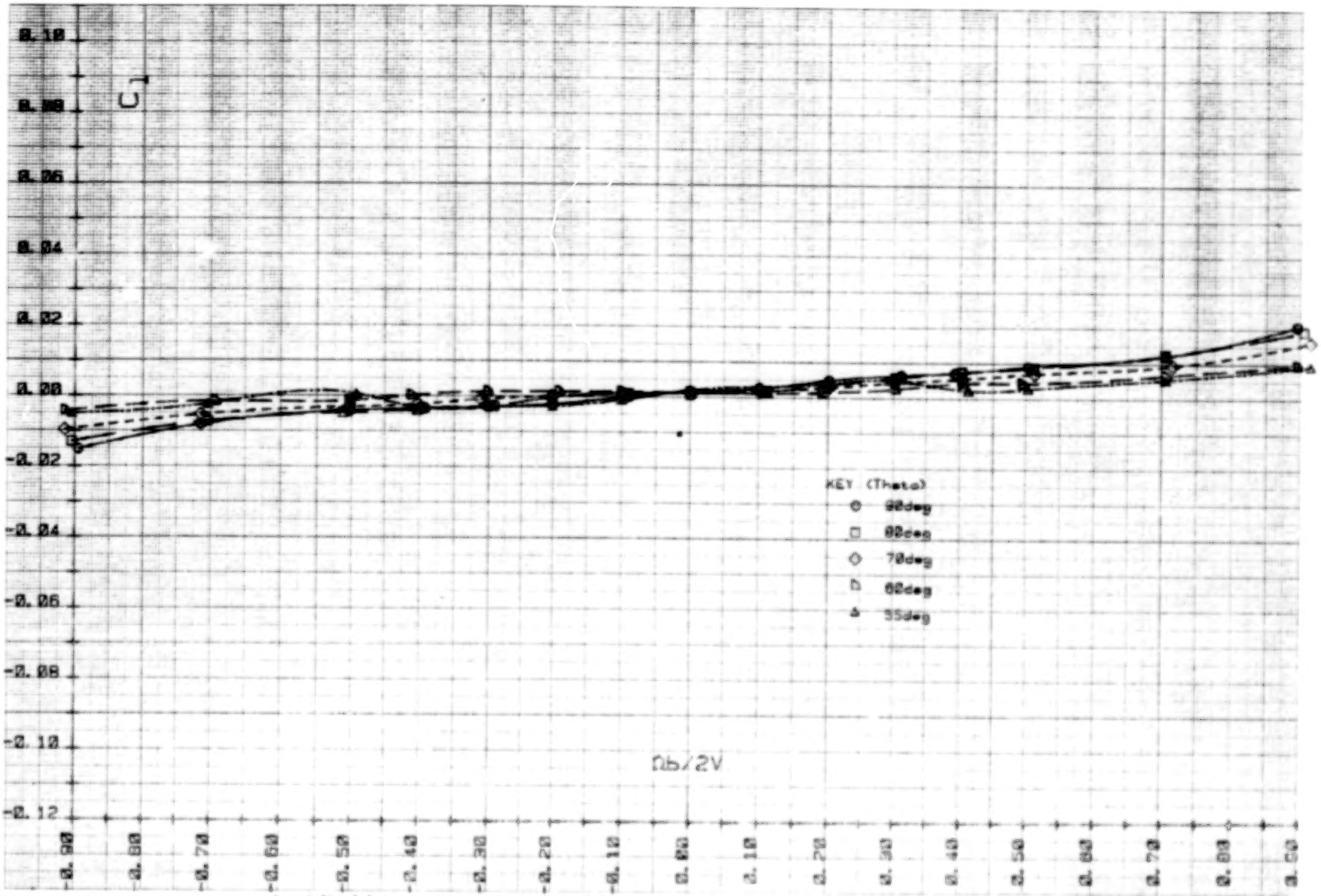
Figure 49.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BW1.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

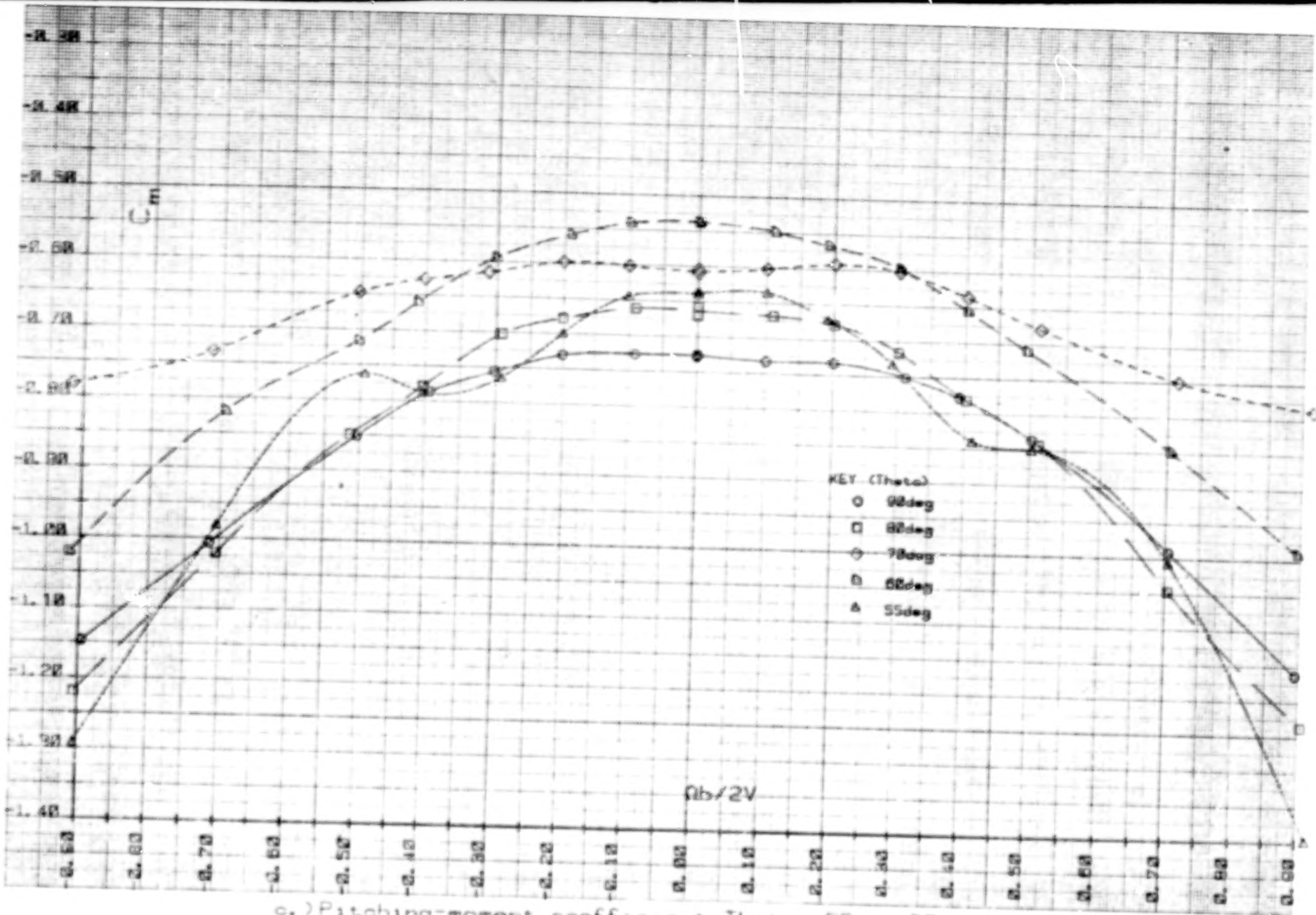
Figure 50. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3.

407



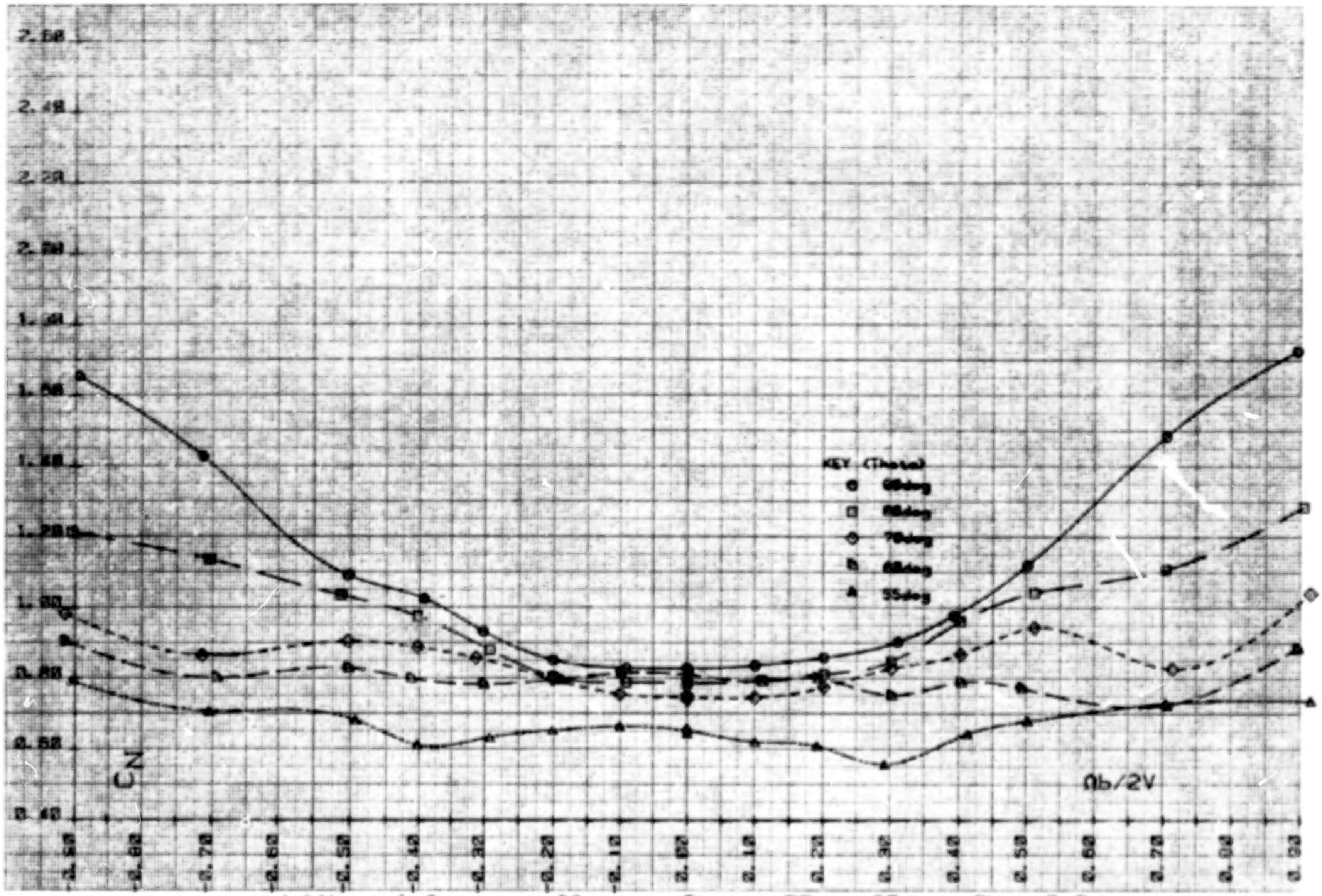
b.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

Figure 50. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3.



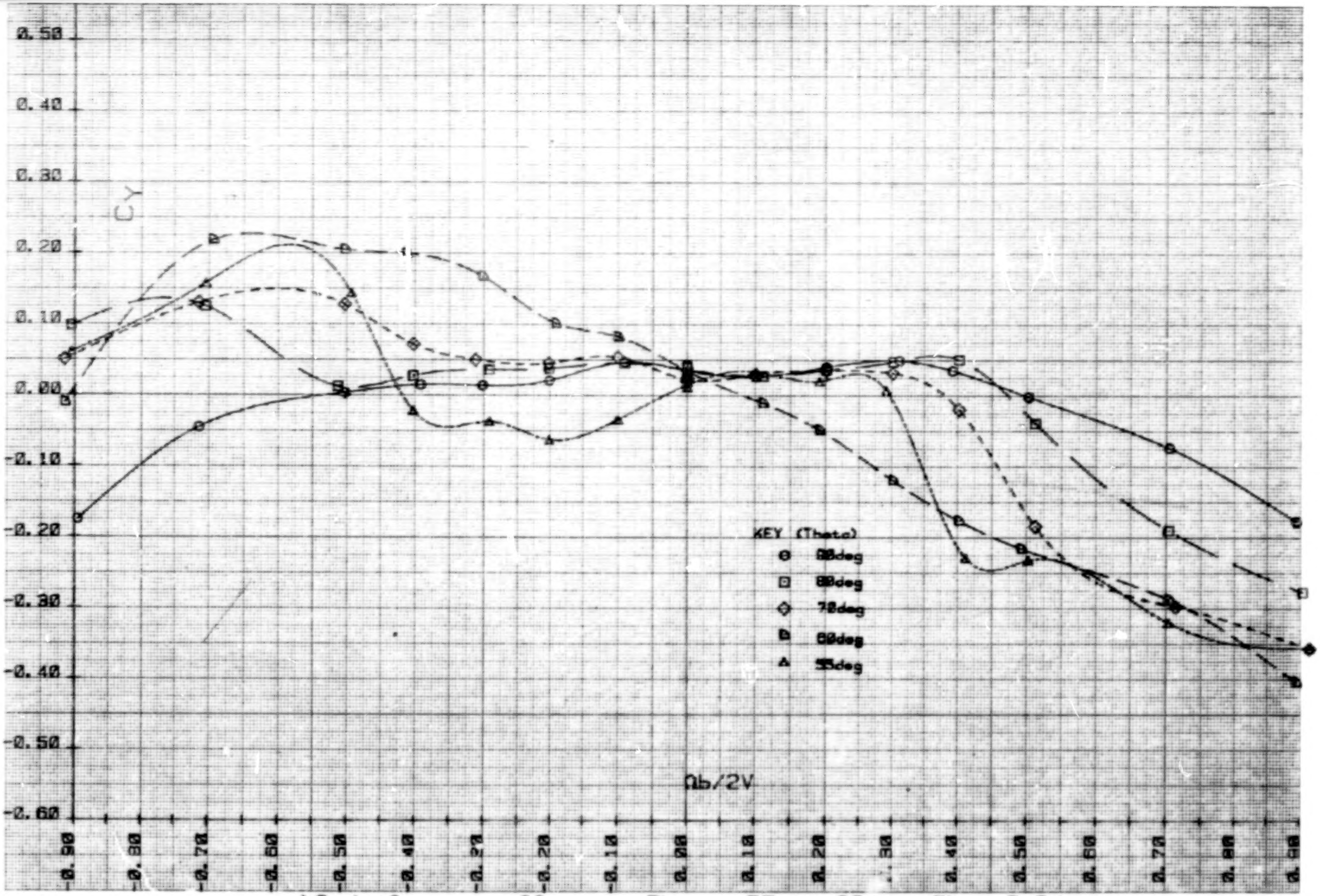
c.) Pitching-moment coefficient. Theta= 55 to 90deg; Phi=-0.3deg.

Figure 50. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3.



d.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

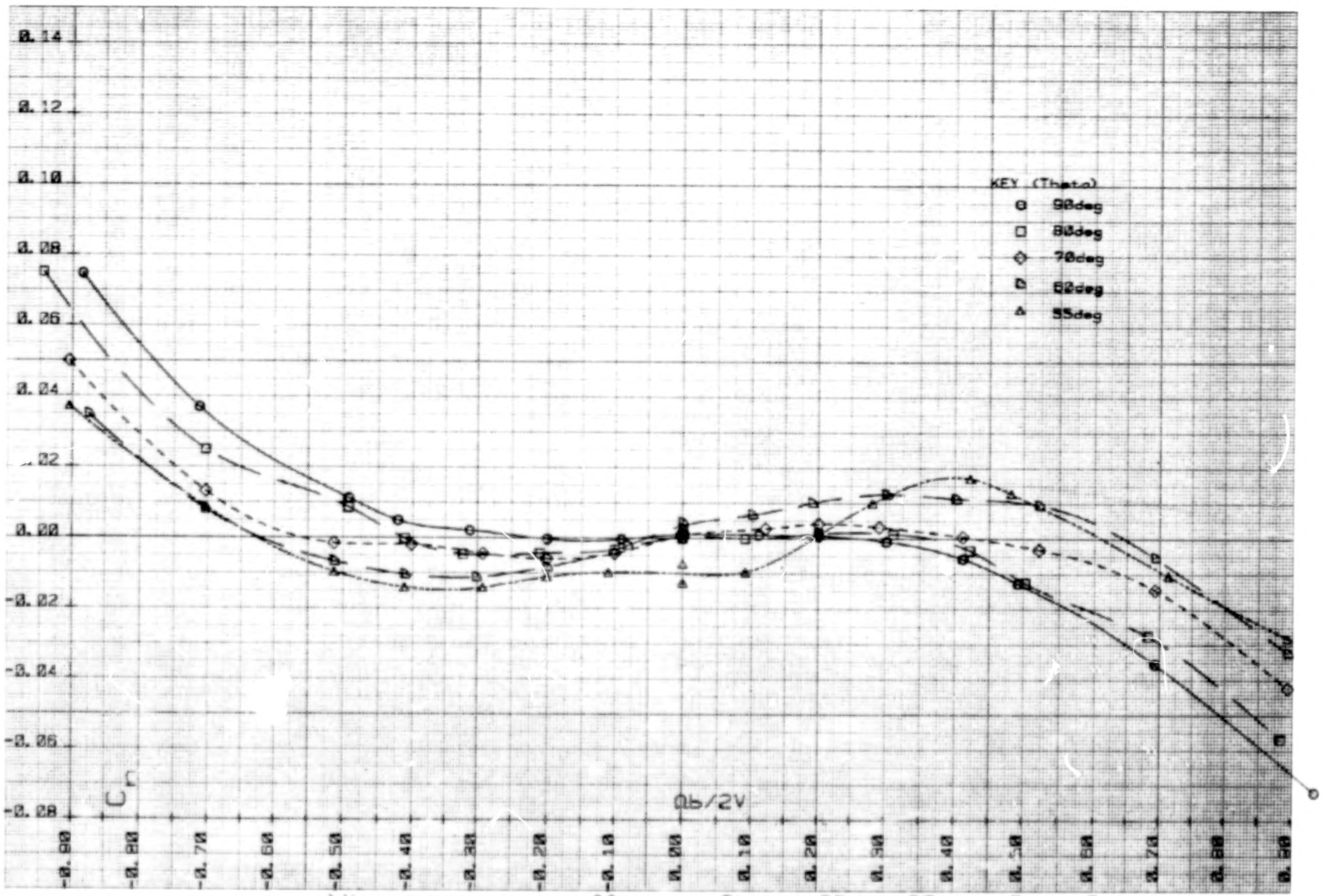
Figure 50.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3.



e.)Side-force coefficient, Theta= 55 to 90deg; Phi=-0.3deg.

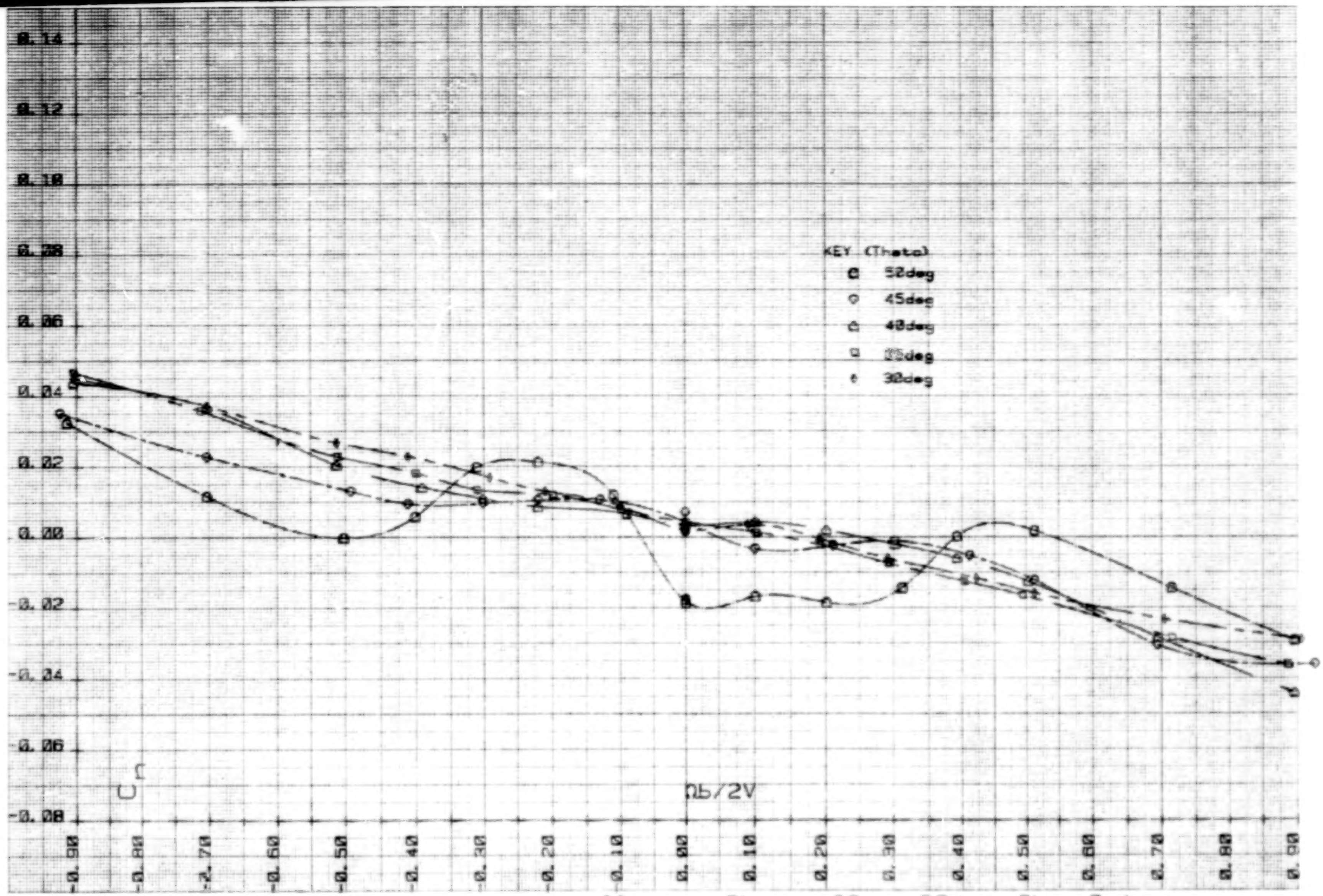
Figure 50.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BH3.

411



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

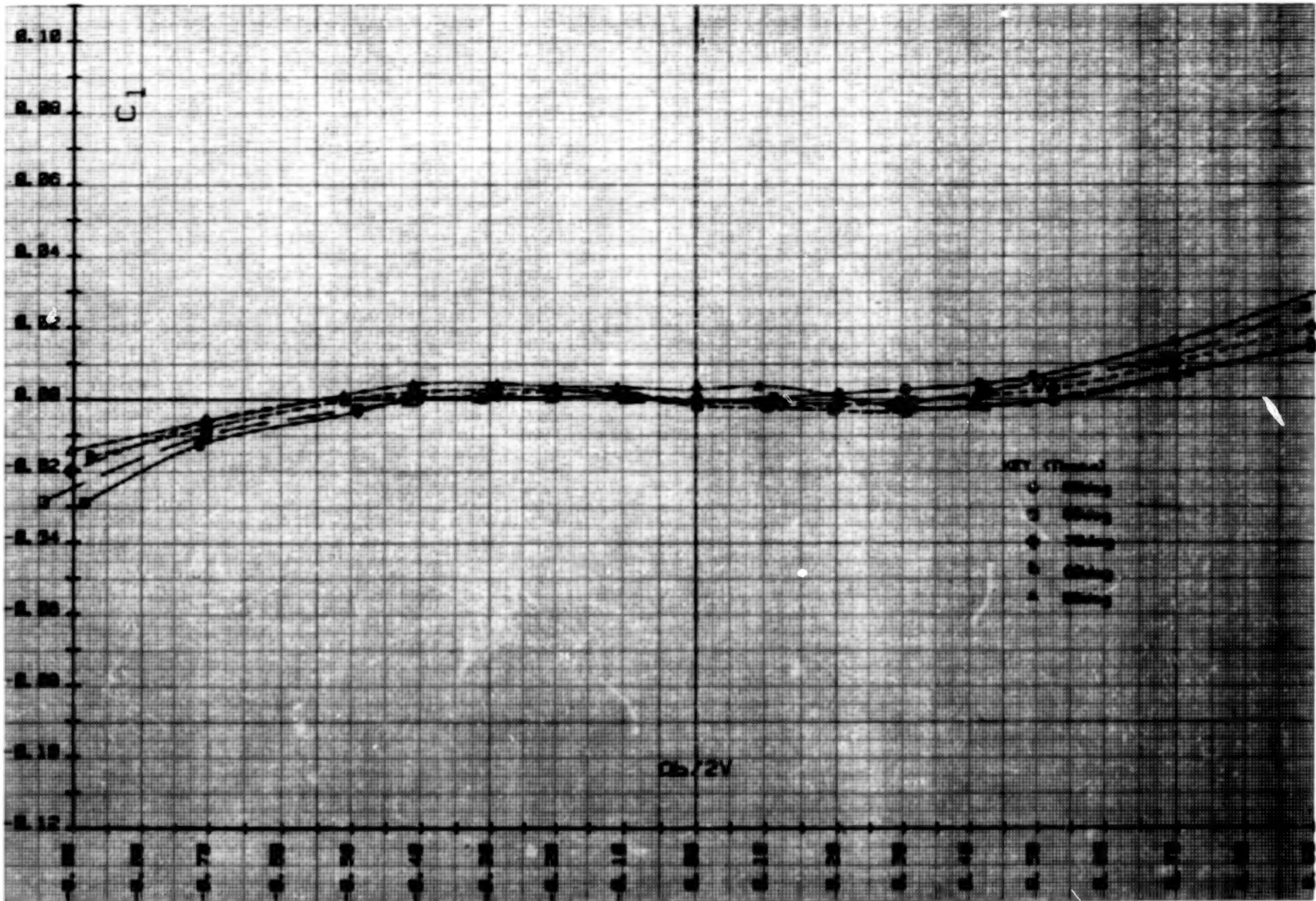
Figure 51.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BV.



(m.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

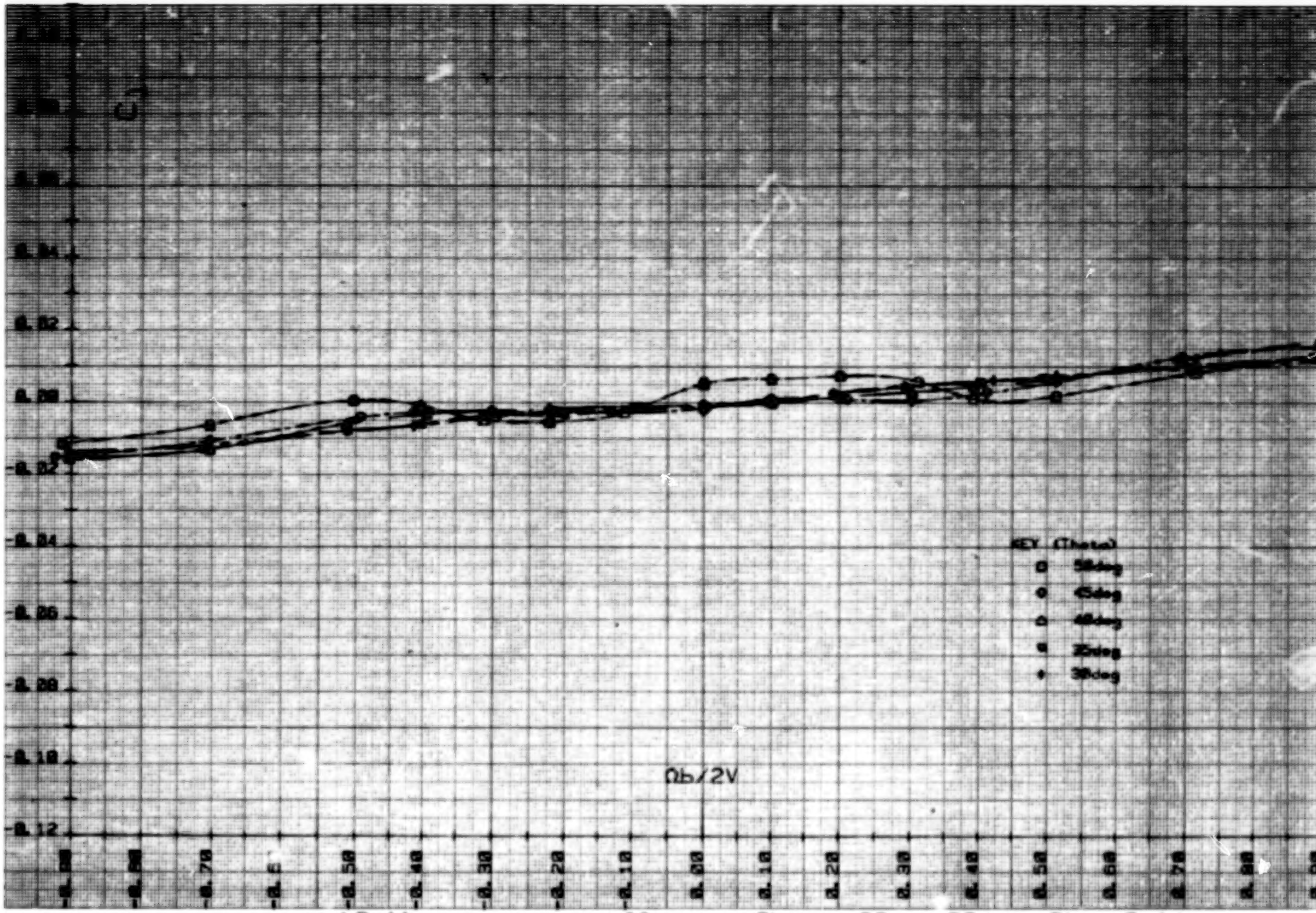
Figure 51.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BV.

414



c.) Rolling-moment coefficient. Theta= 55 to 90deg; Phi=-0.1deg.

Figure 51.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BV.



d.) Rolling-moment coefficient. Theta= 30 to 50deg; Phi=-0.4deg.

Figure 51.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BV.

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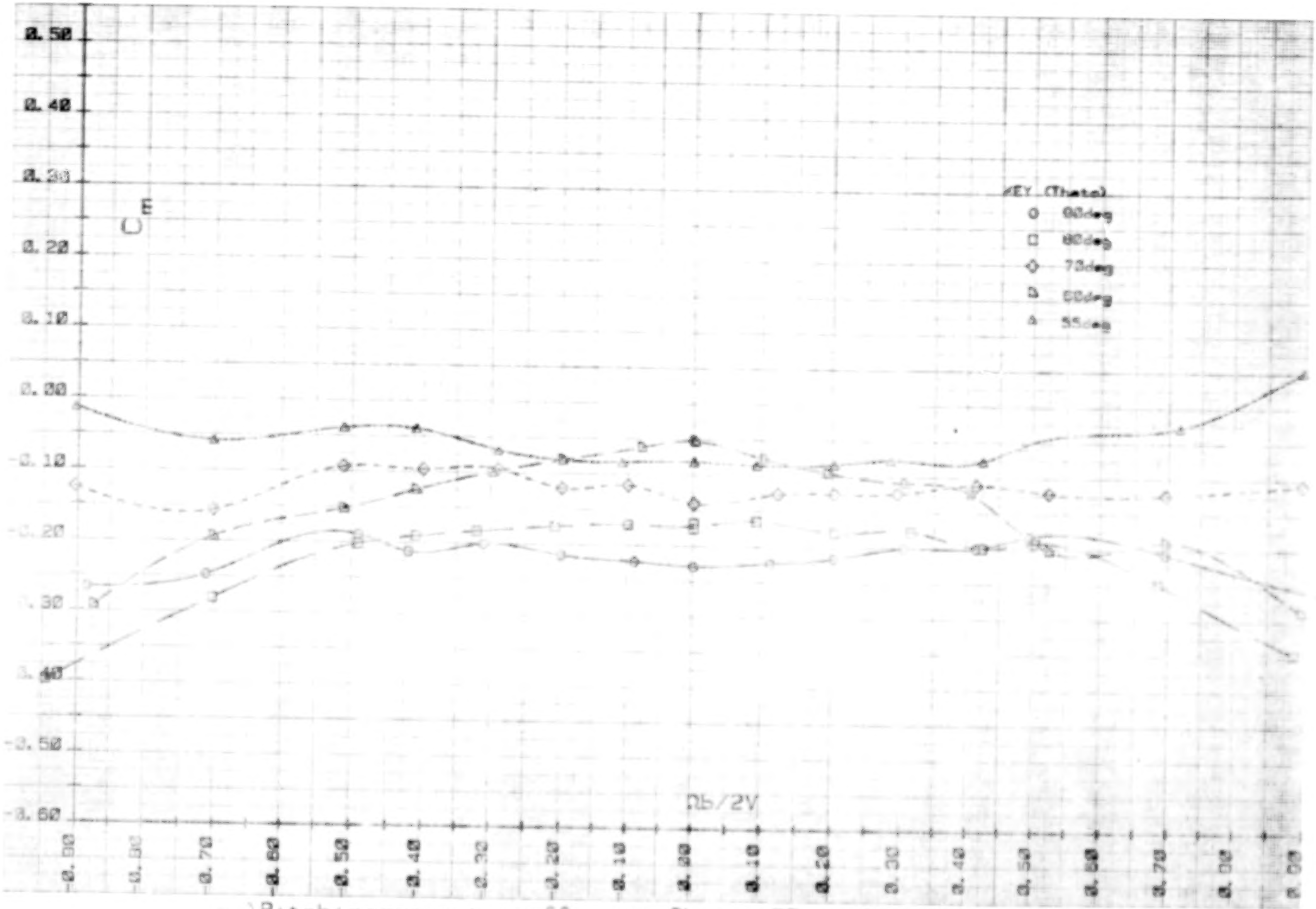
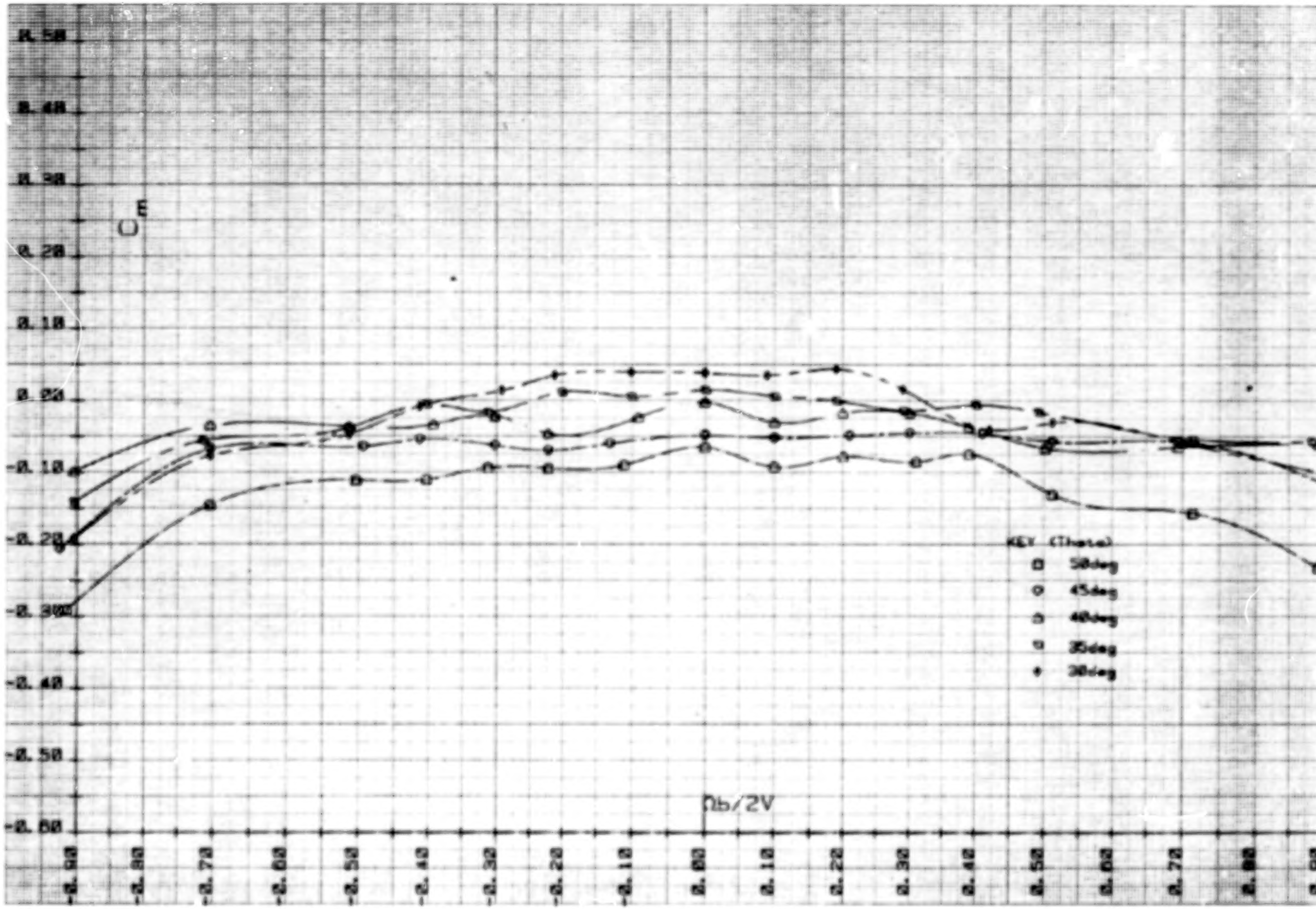


(.)Pitching-moment coefficient. Theta= 55 to 90deg; Phi=-0.1deg.

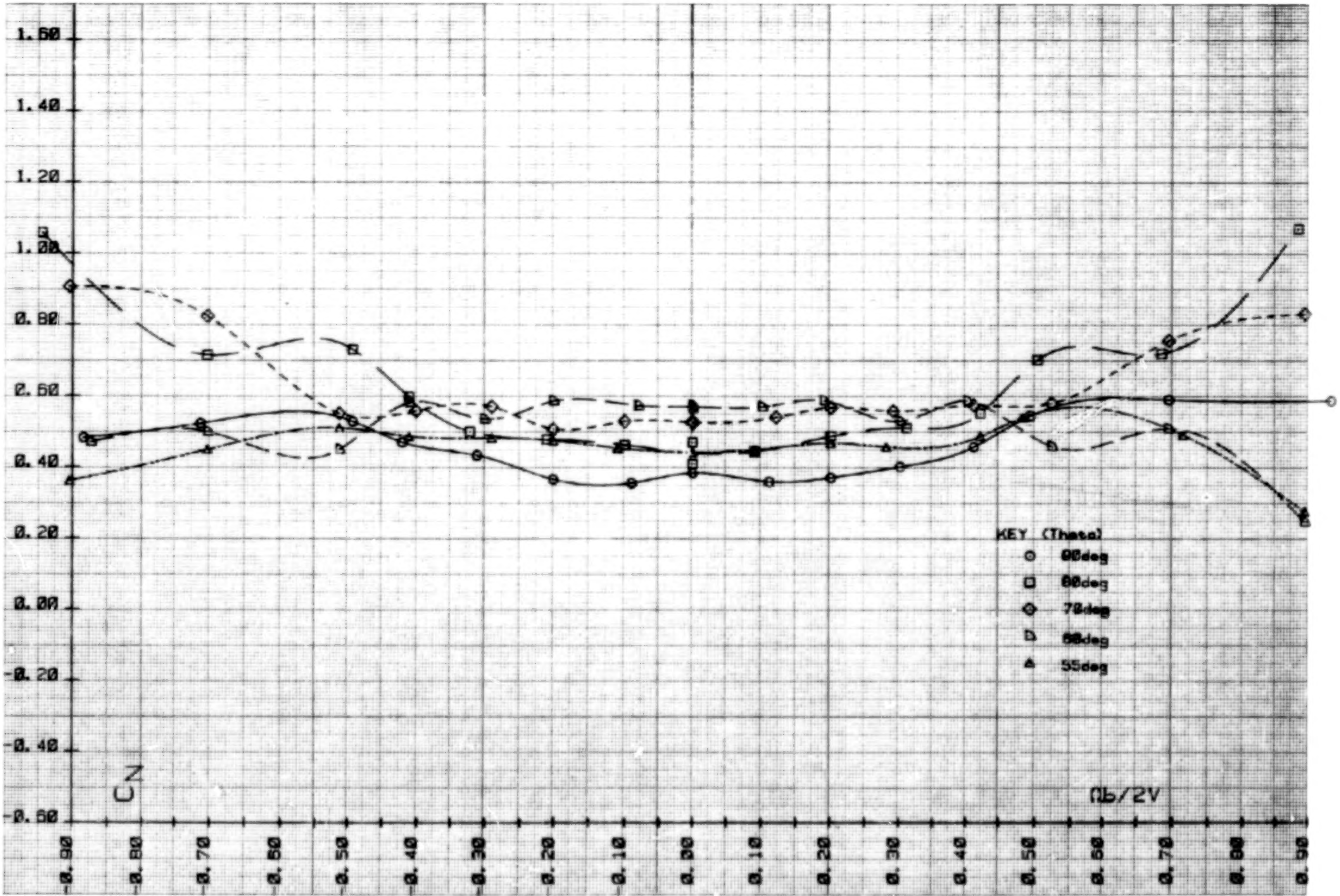
Figure 51.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BV.



(.)Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

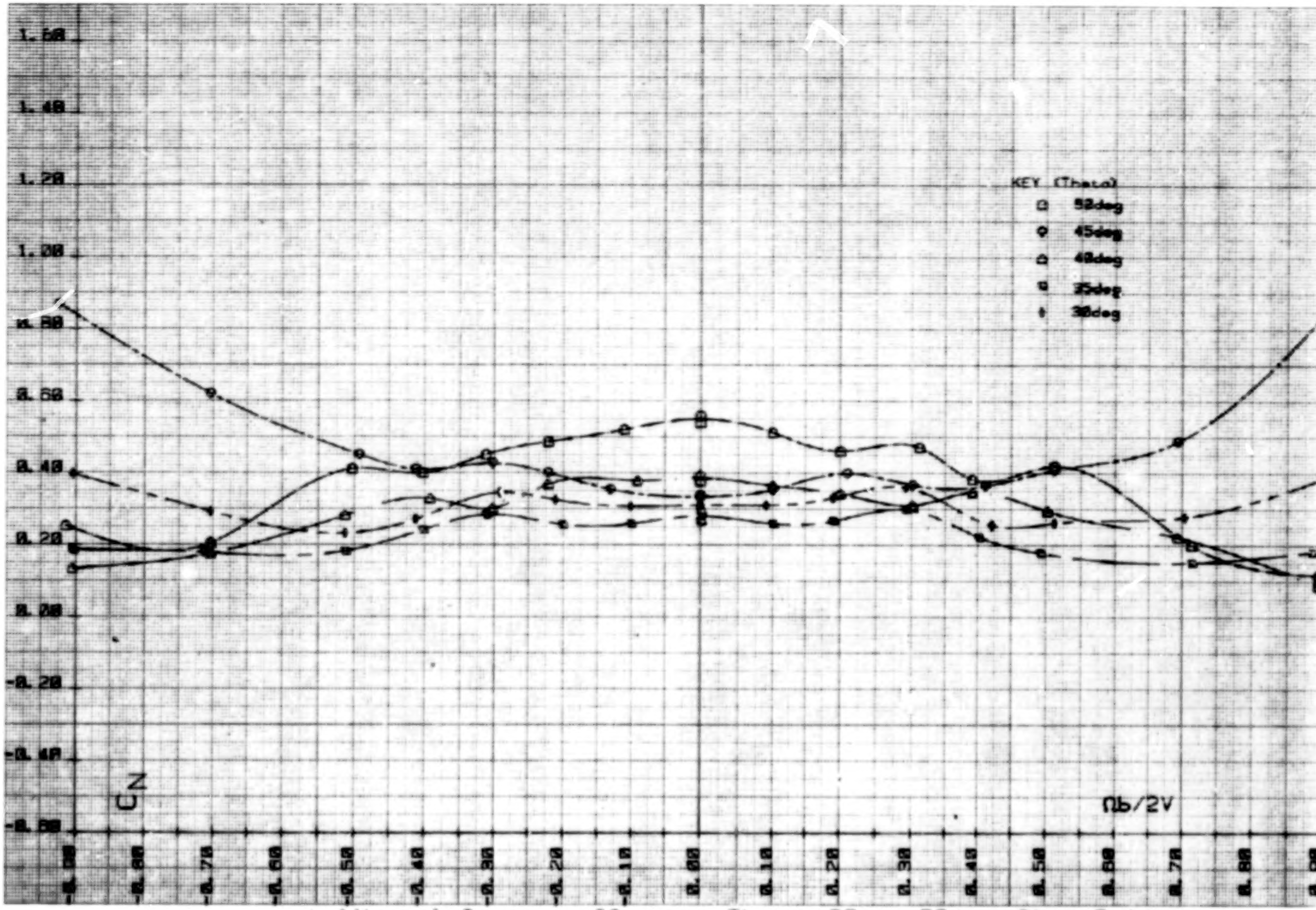
417 Figure 51.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BV.

418



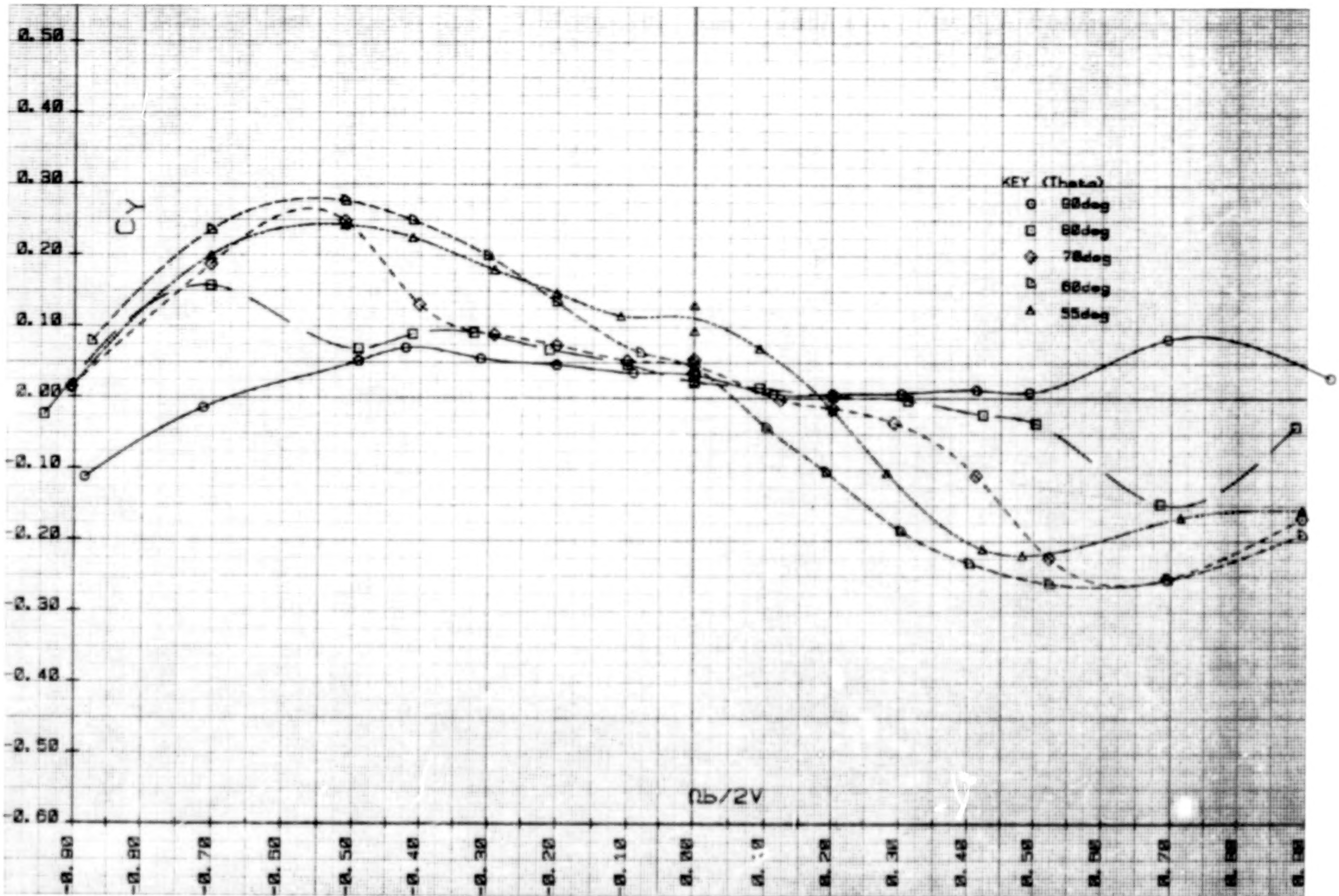
g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

Figure 51.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BV.



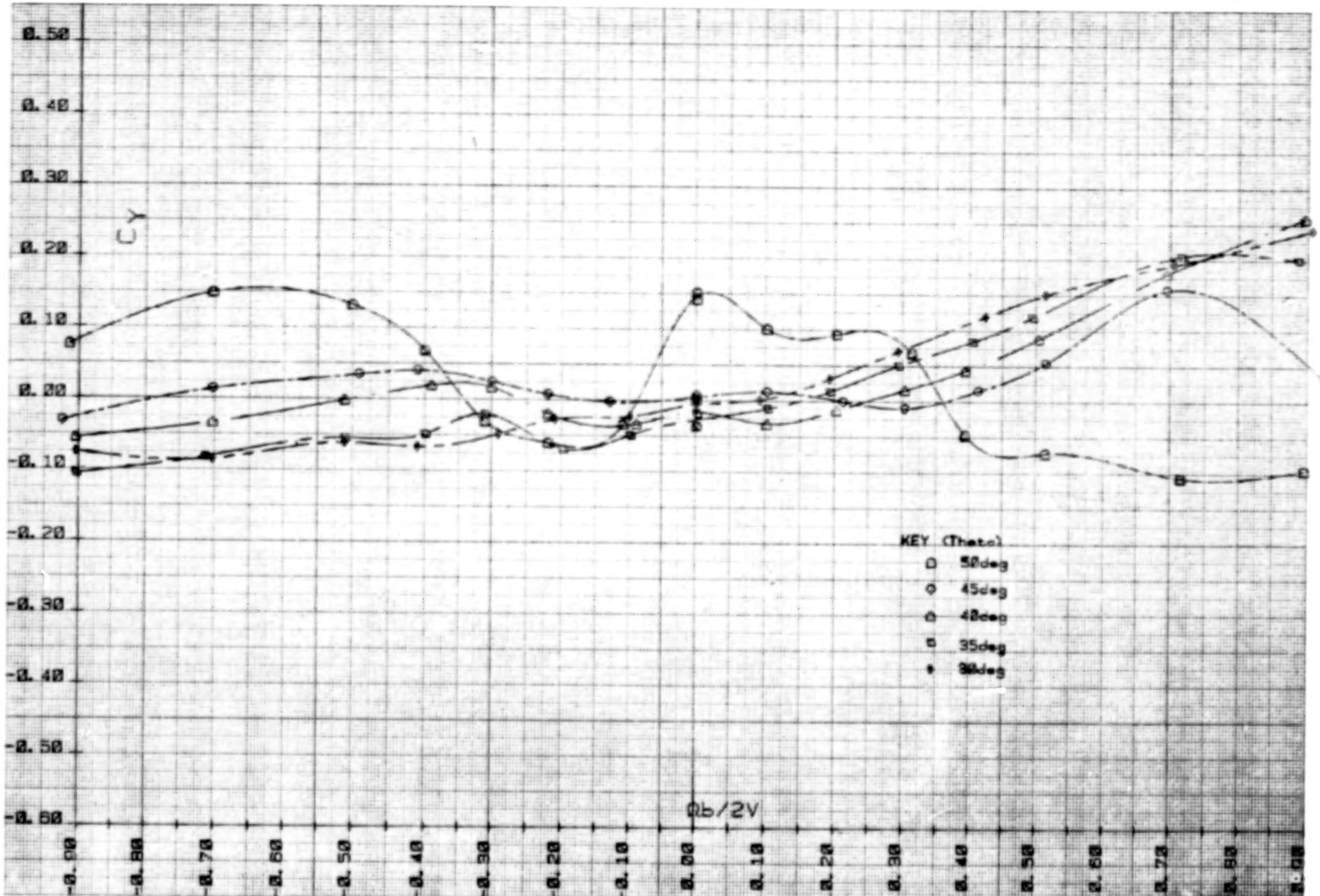
h.) Normal-force coefficient. Theta= 30 to 50deg; Phi=-0.4deg.

419 Figure 51.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BV.



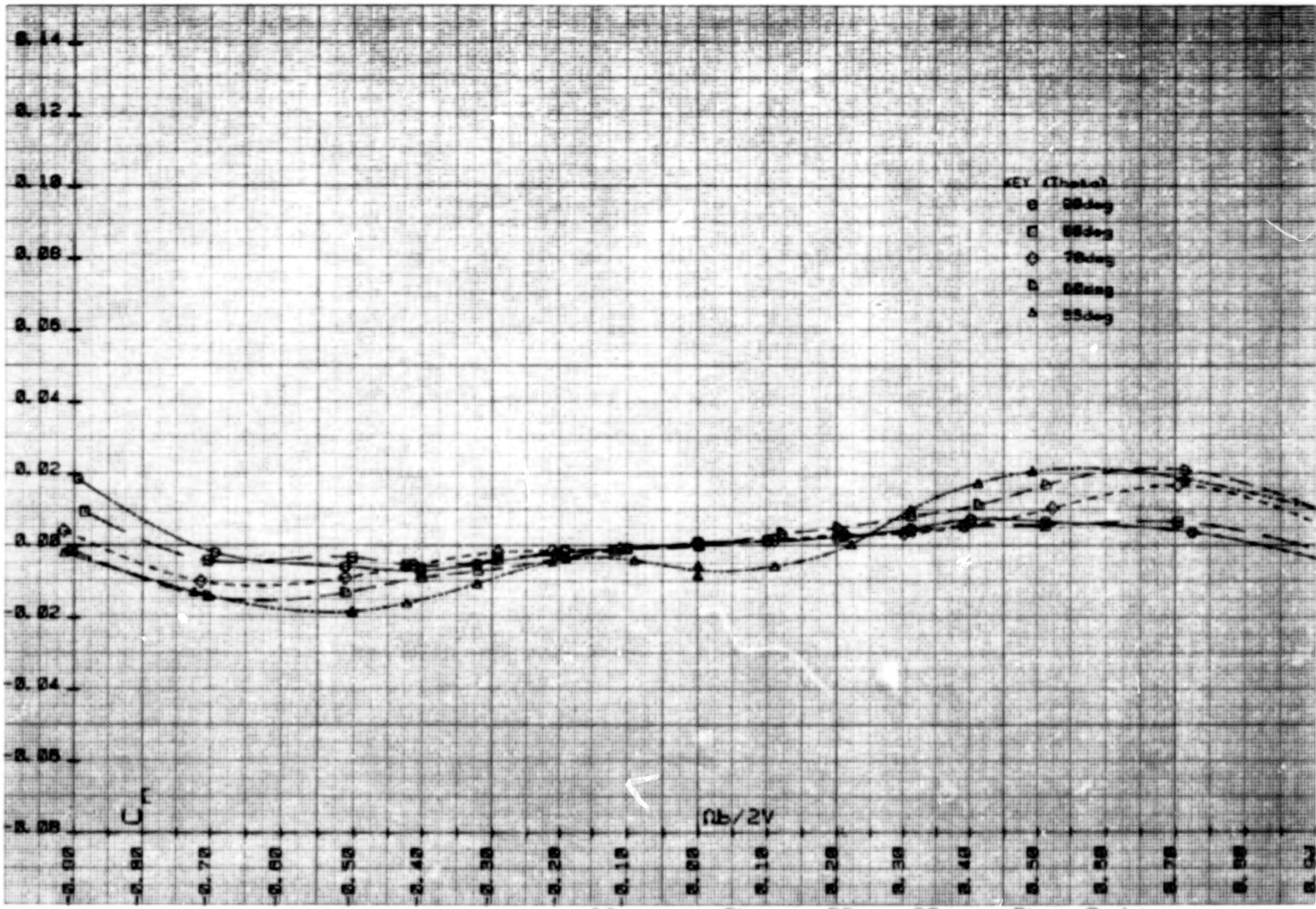
..)Side-force coefficient, Theta= 55 to 90deg; Phi=-0.1deg.

Figure 51. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BV.



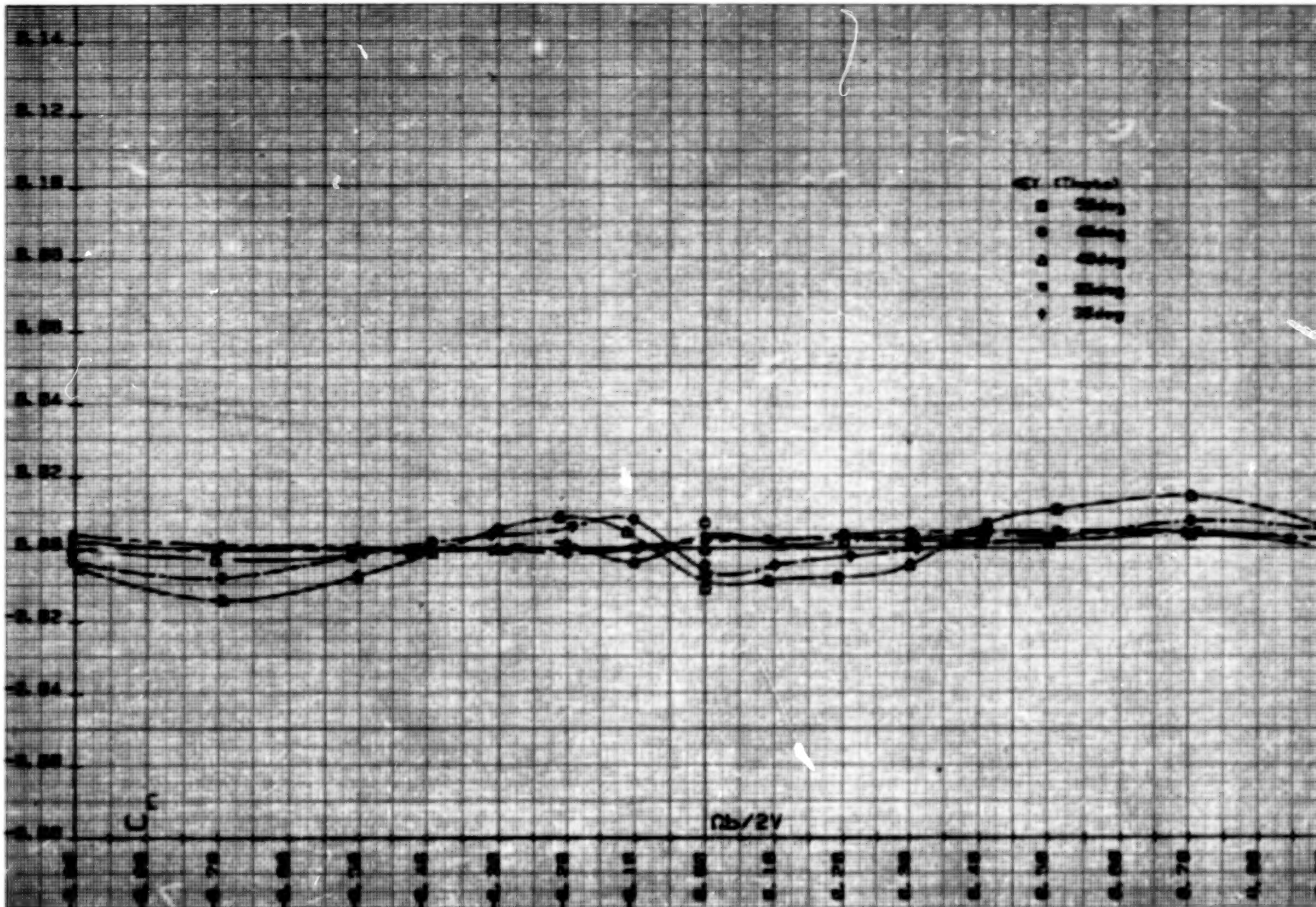
(j) Side-force coefficient, Theta= 30 to 50deg; Phi=-0.1deg.

Figure 51.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration BV.



a.) Yawing-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 52.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration B.



b.) Yawing-moment coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

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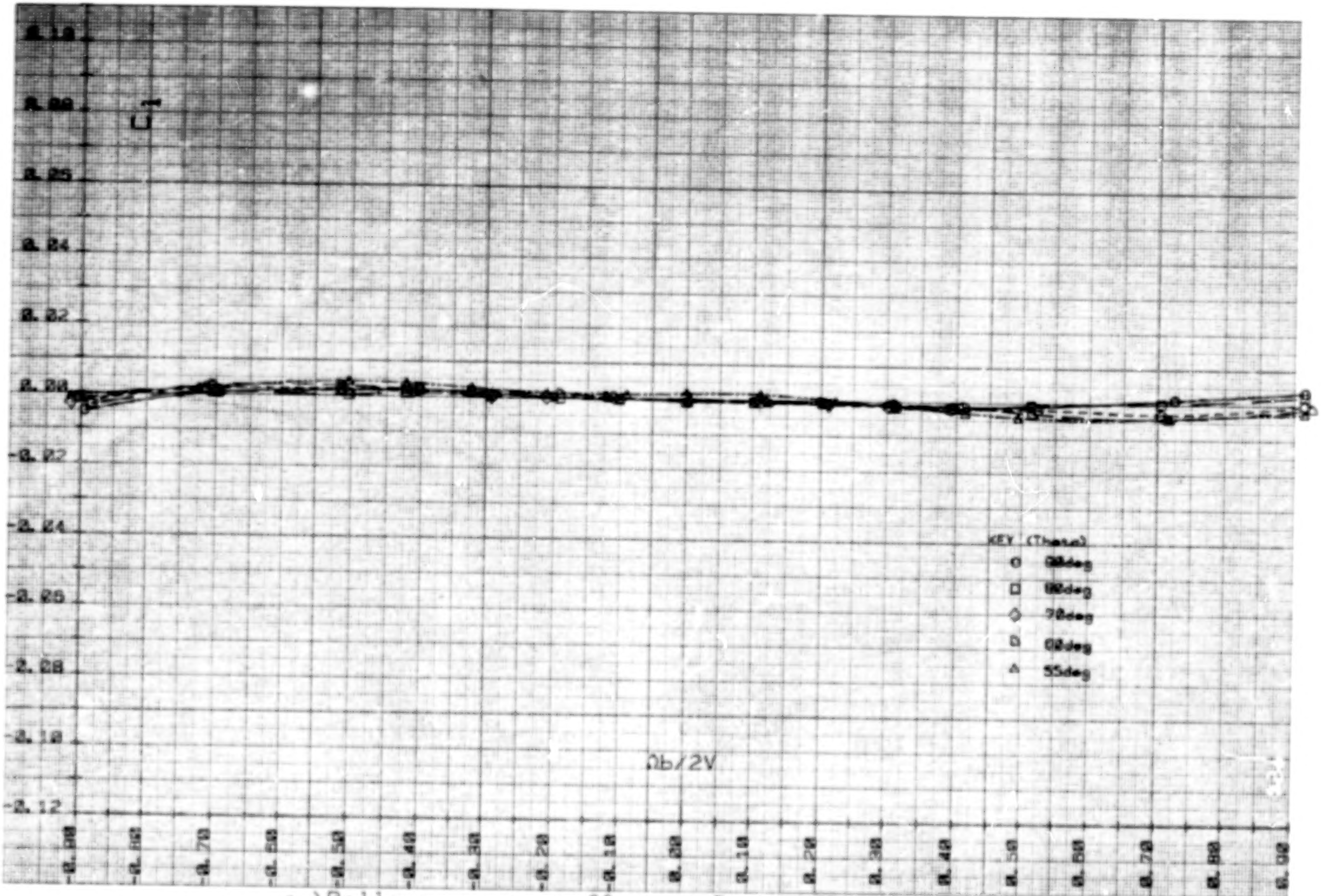
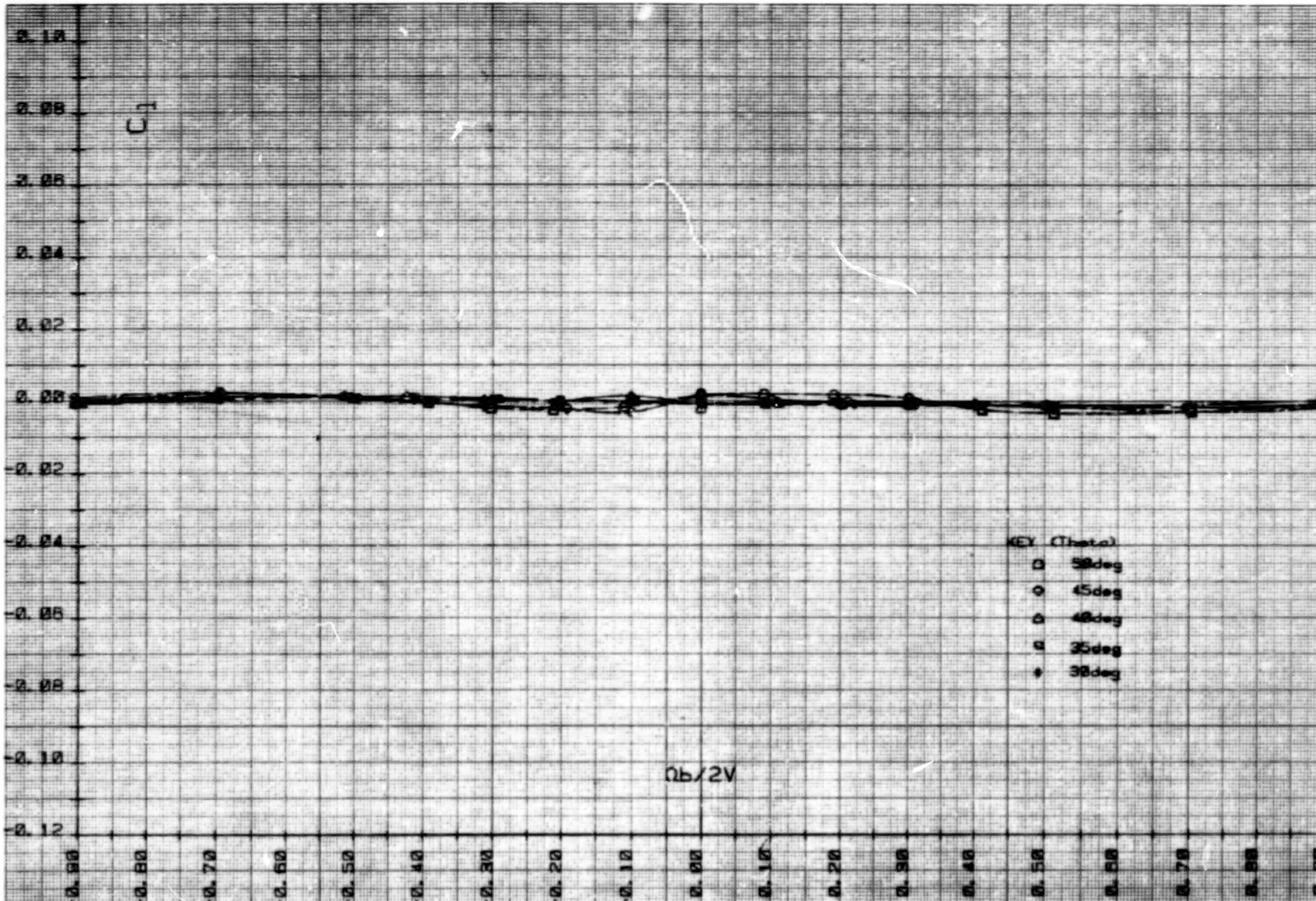
Figure 52.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration B.



(c.) Rolling-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

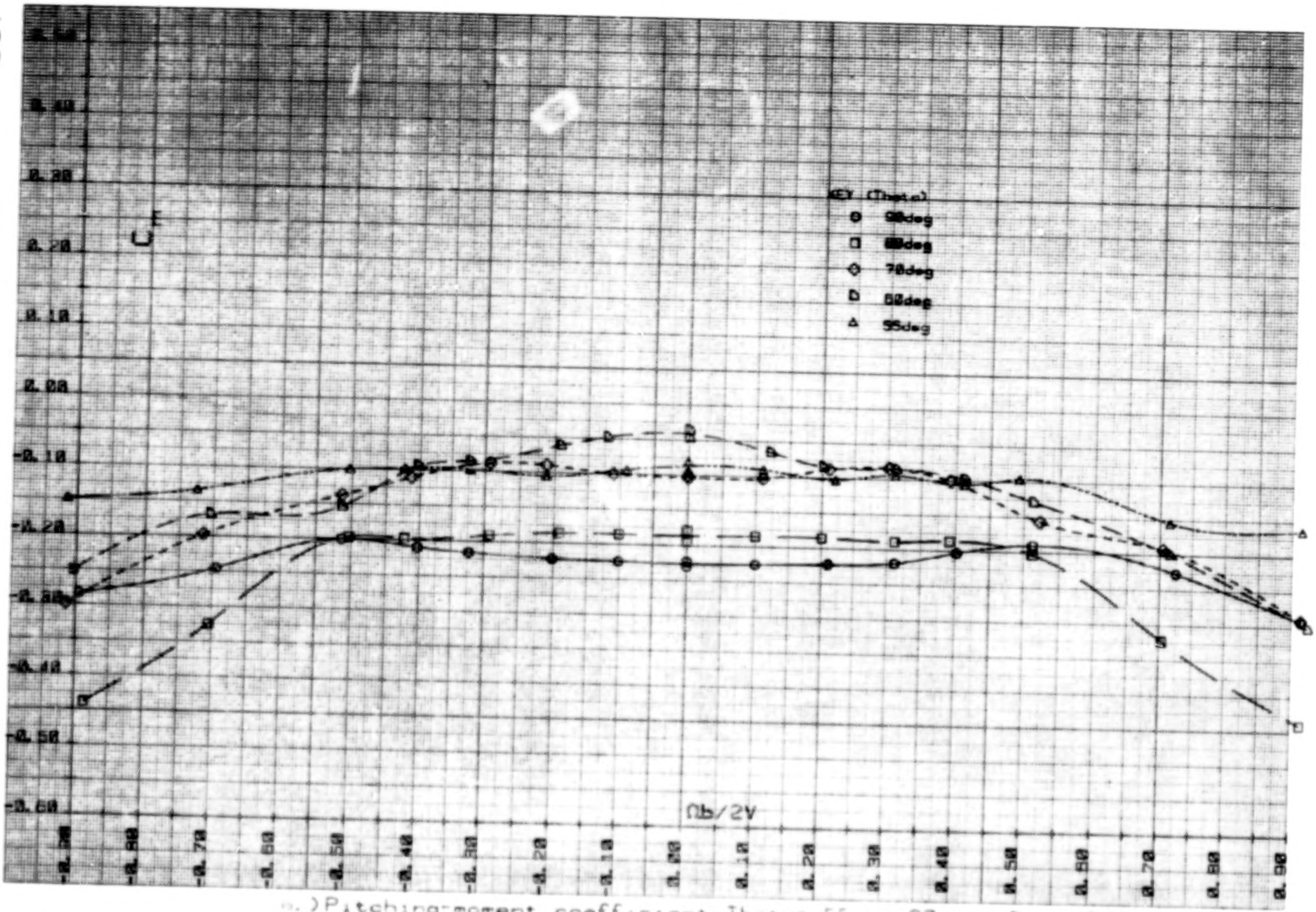
Figure 52.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration B.



d.) Rolling-moment coefficient, Theta= 30 to 50deg: Phi=-0.4deg.

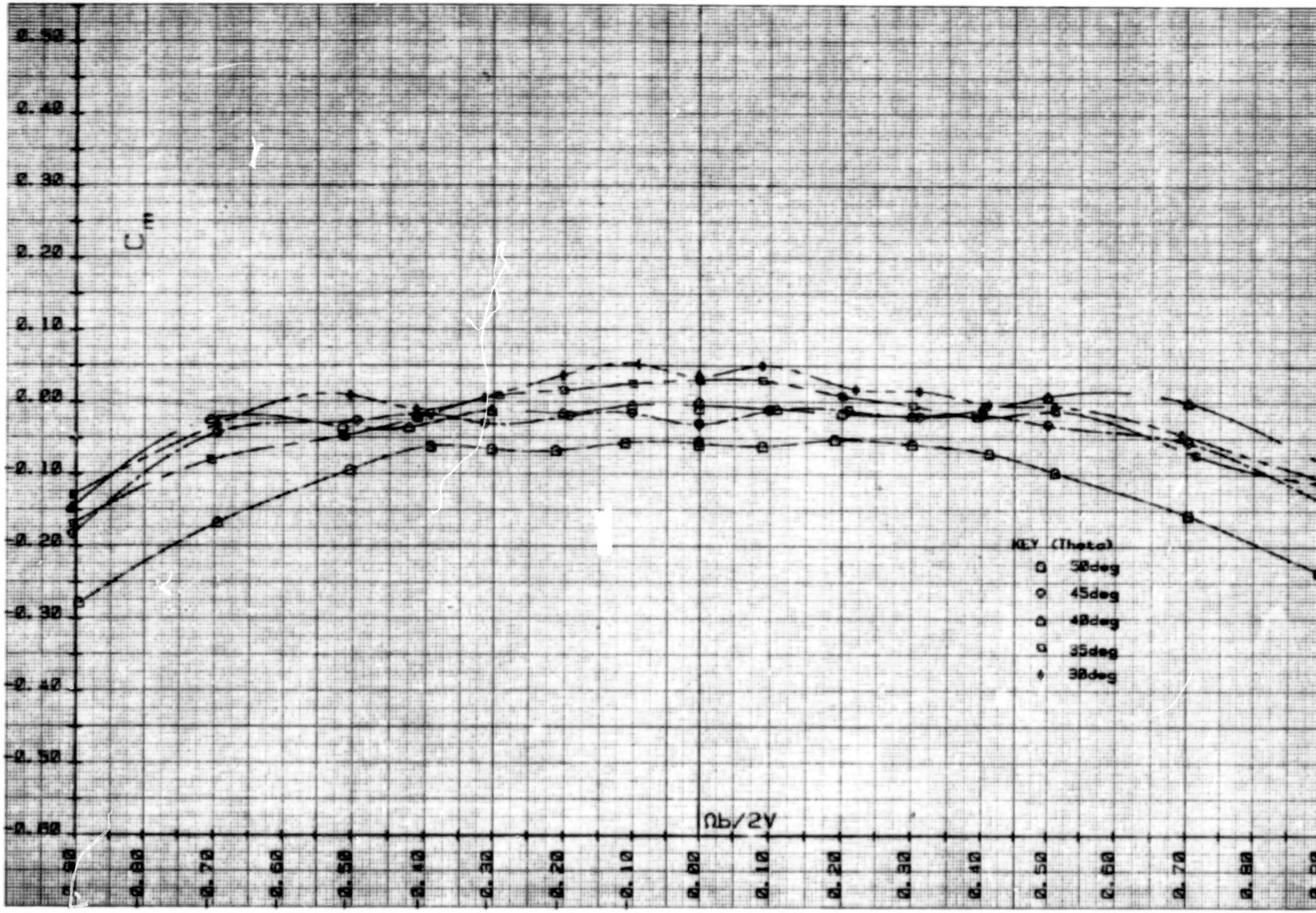
Figure 52.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration B.

425



a.) Pitching-moment coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 52. -Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration B.



f.) Pitching-moment coefficient, Theta= 30 to 50deg; Phi=-0.4deg.

Figure 52.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration B.

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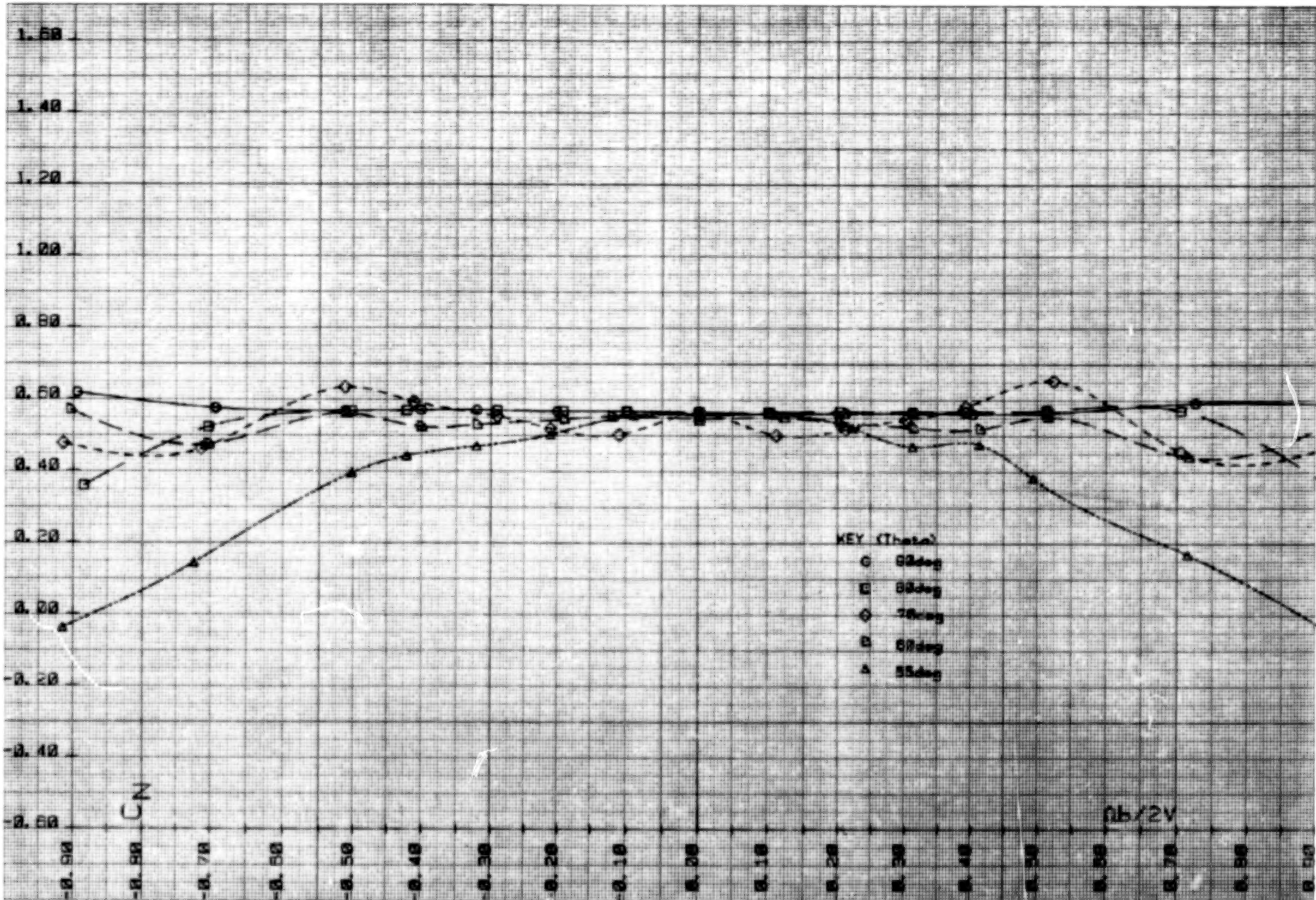
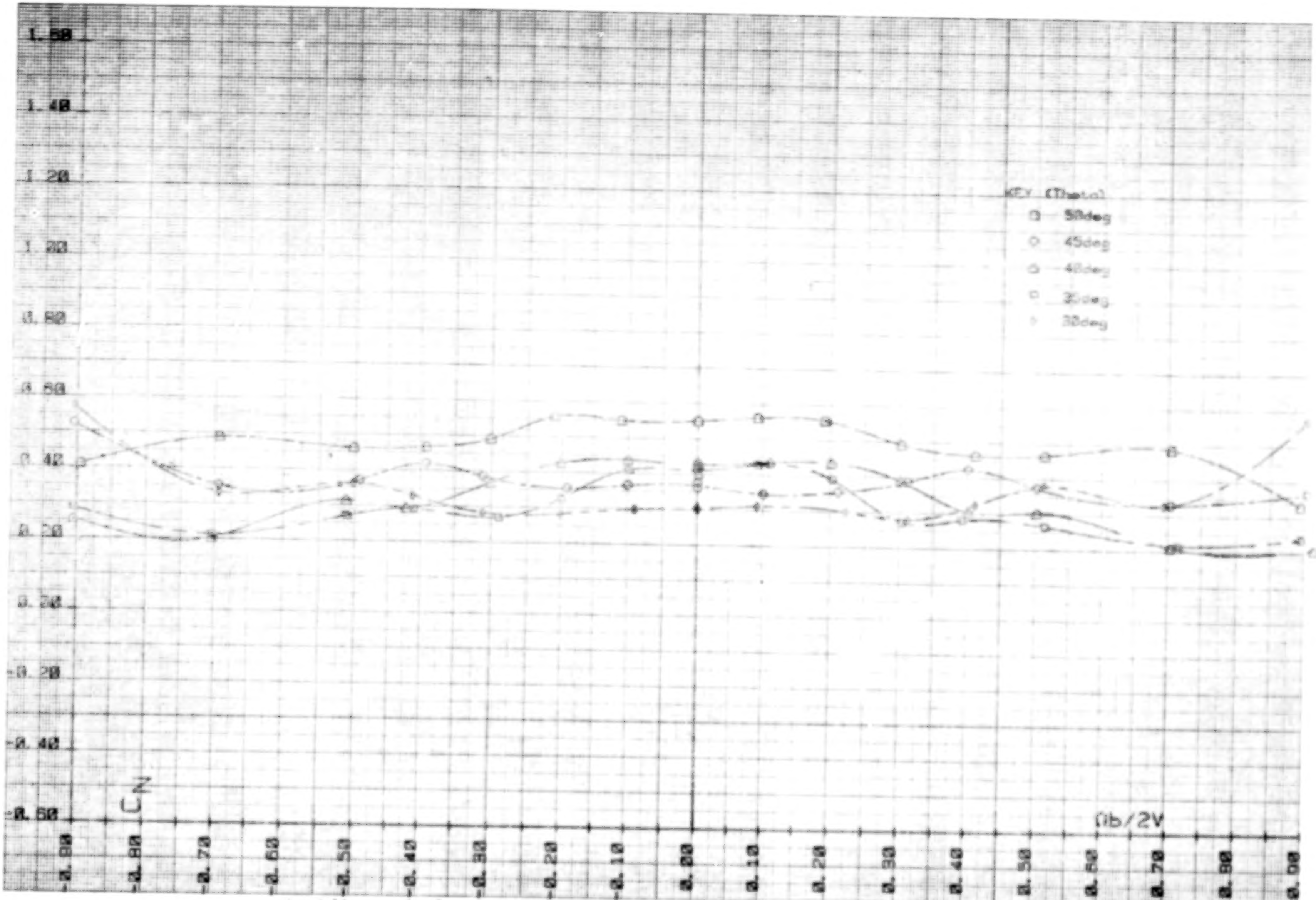


g.) Normal-force coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 52.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration B.



(b.) Normal-force coefficient. Theta= 30 to 50deg; Phi=-0.4deg.

Figure 52.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration B.

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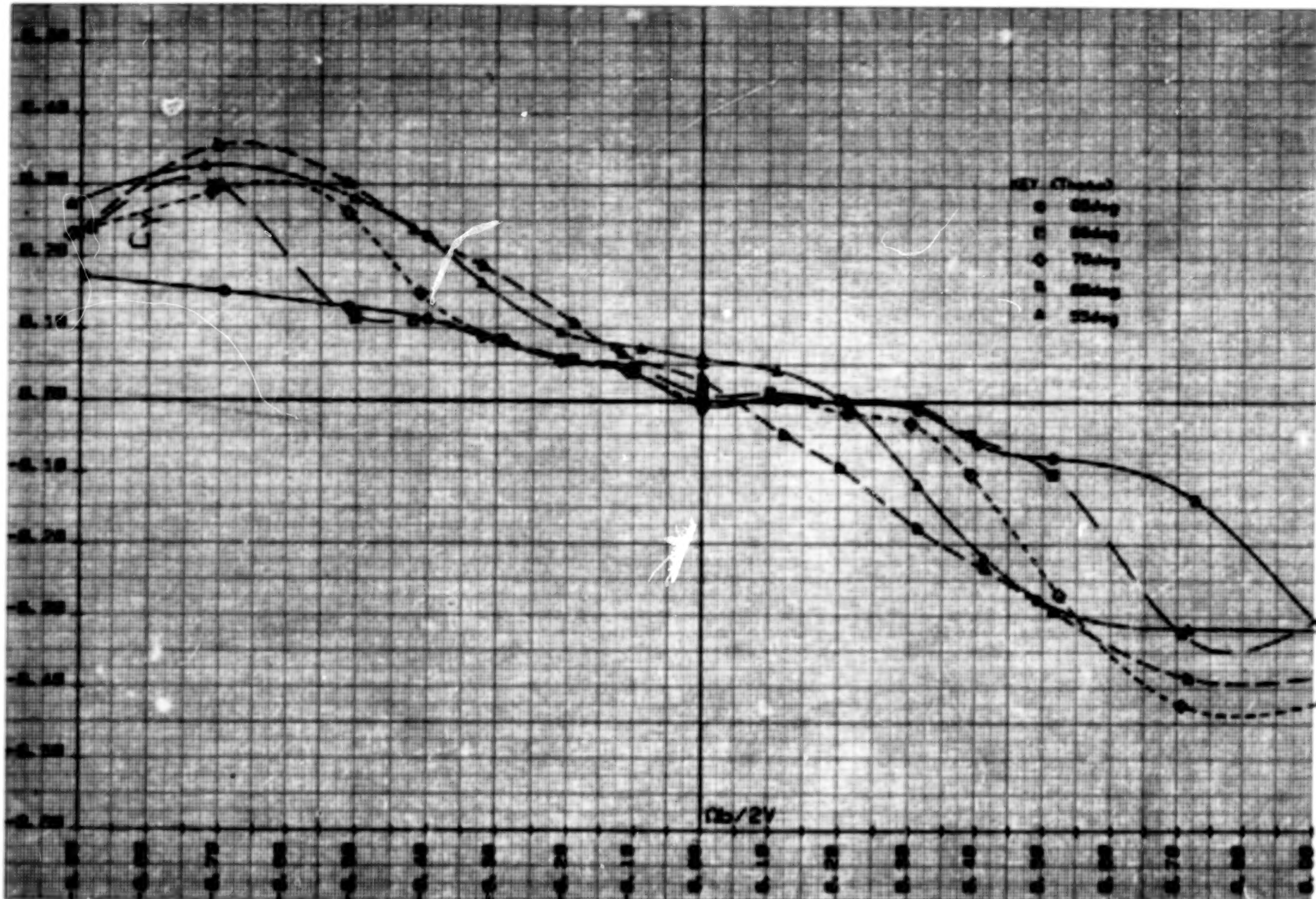
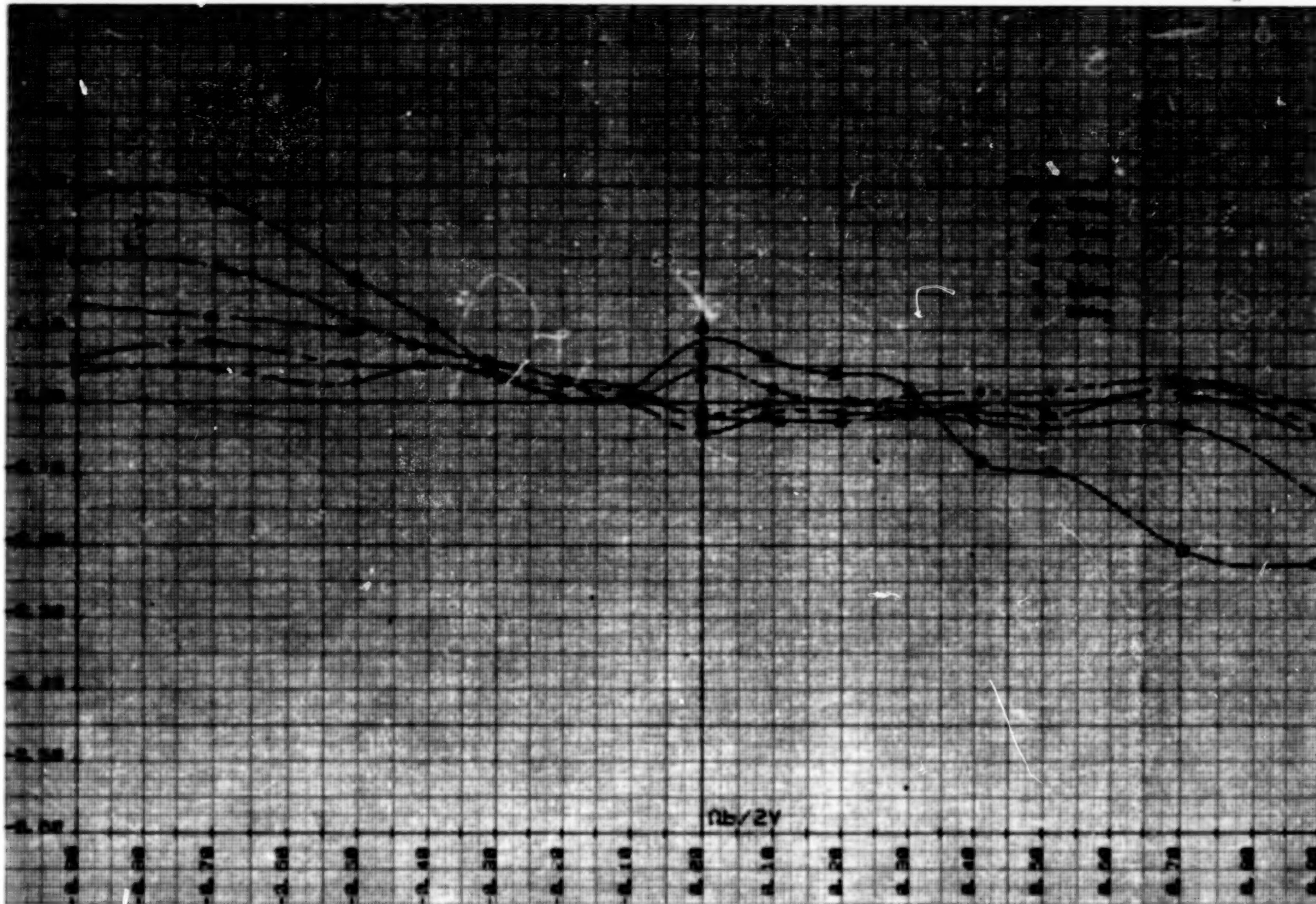


1.) Side-force coefficient, Theta= 55 to 90deg; Phi=-0.4deg.

Figure 52.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration B.



.)Side-force coefficient, Theta= 30 to 50deg: Phi=-0.4deg.

Figure 52.-Effect of rotation rate and pitch and roll attitude angles on aerodynamic characteristics for configuration B.

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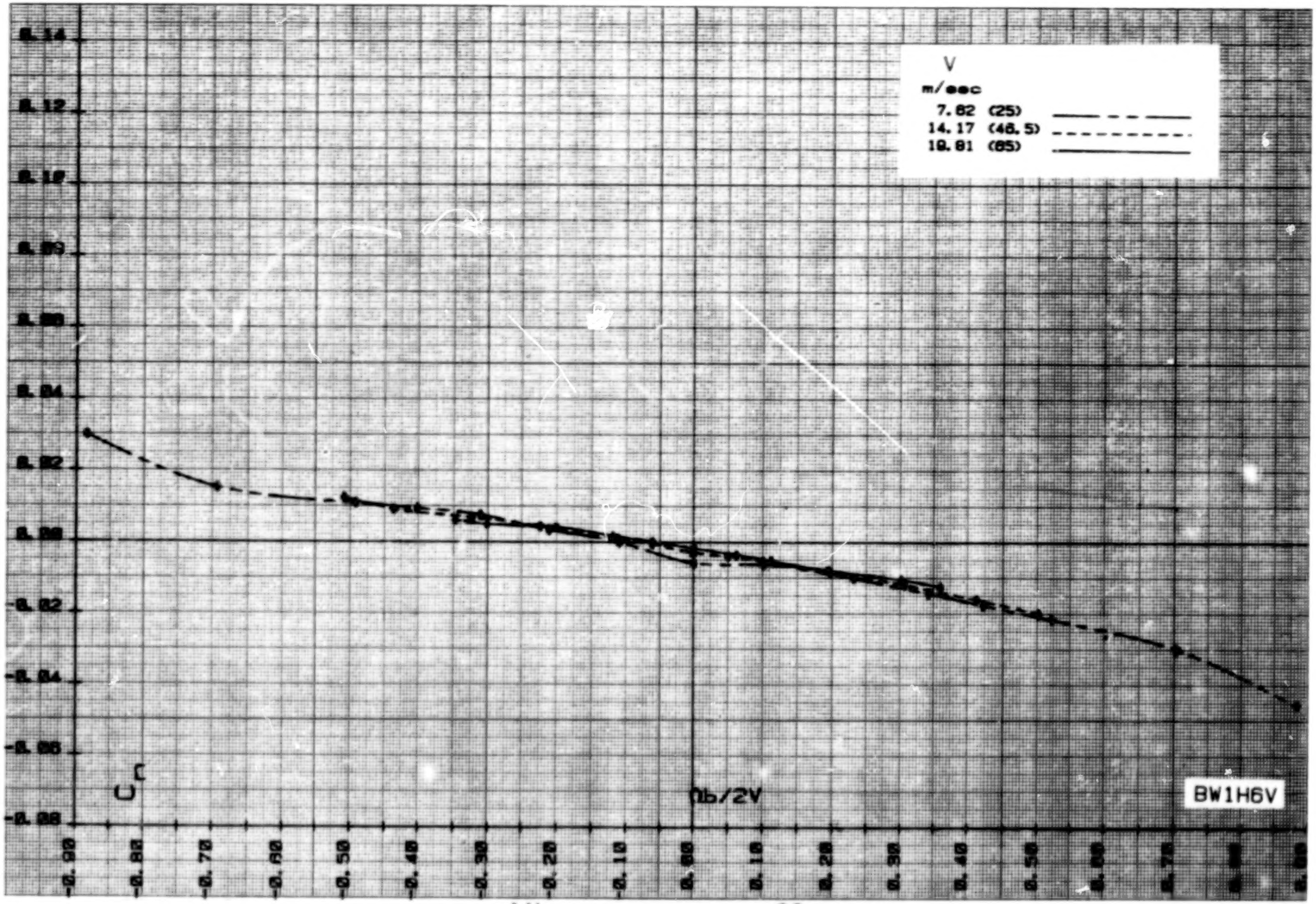
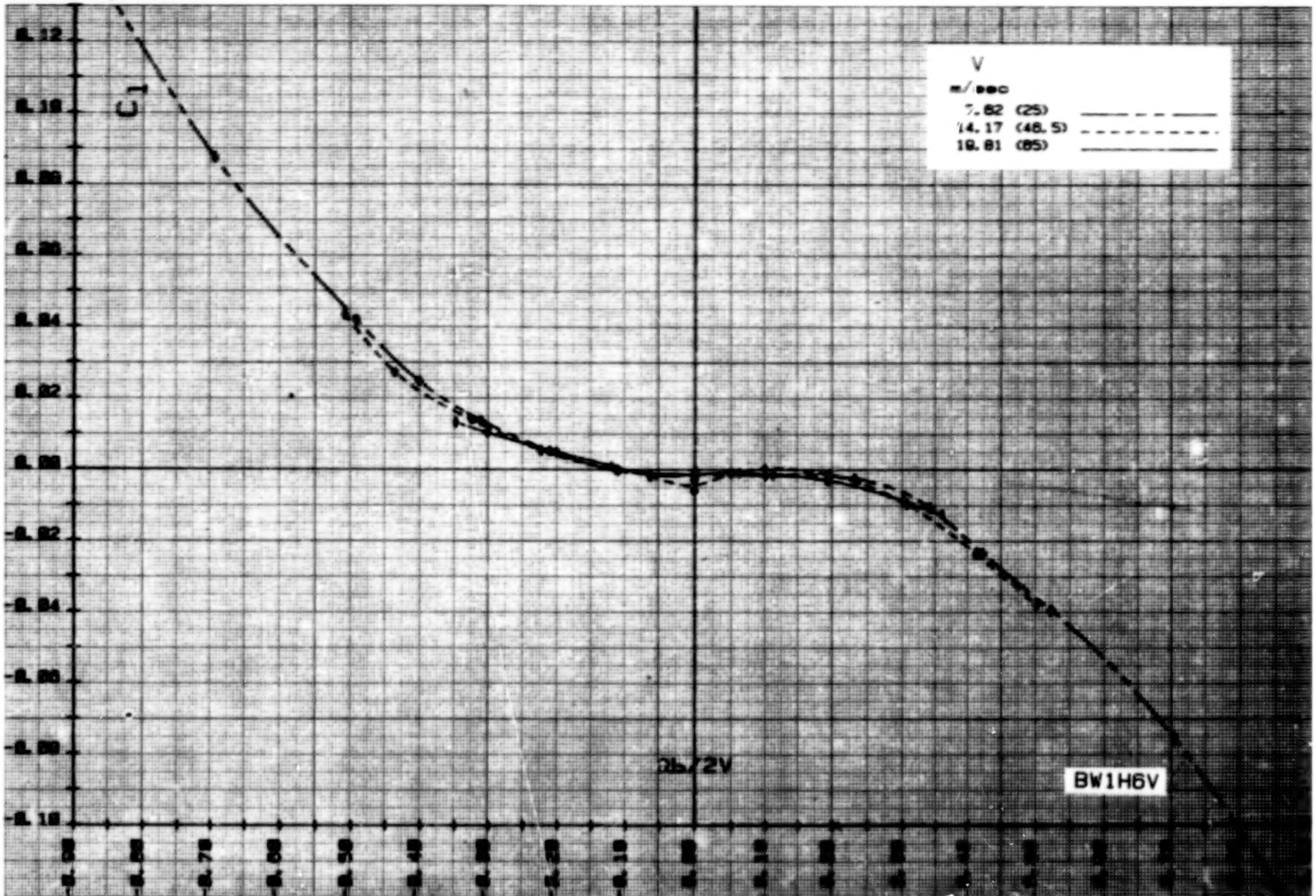


a.) Yawing-moment coefficient.

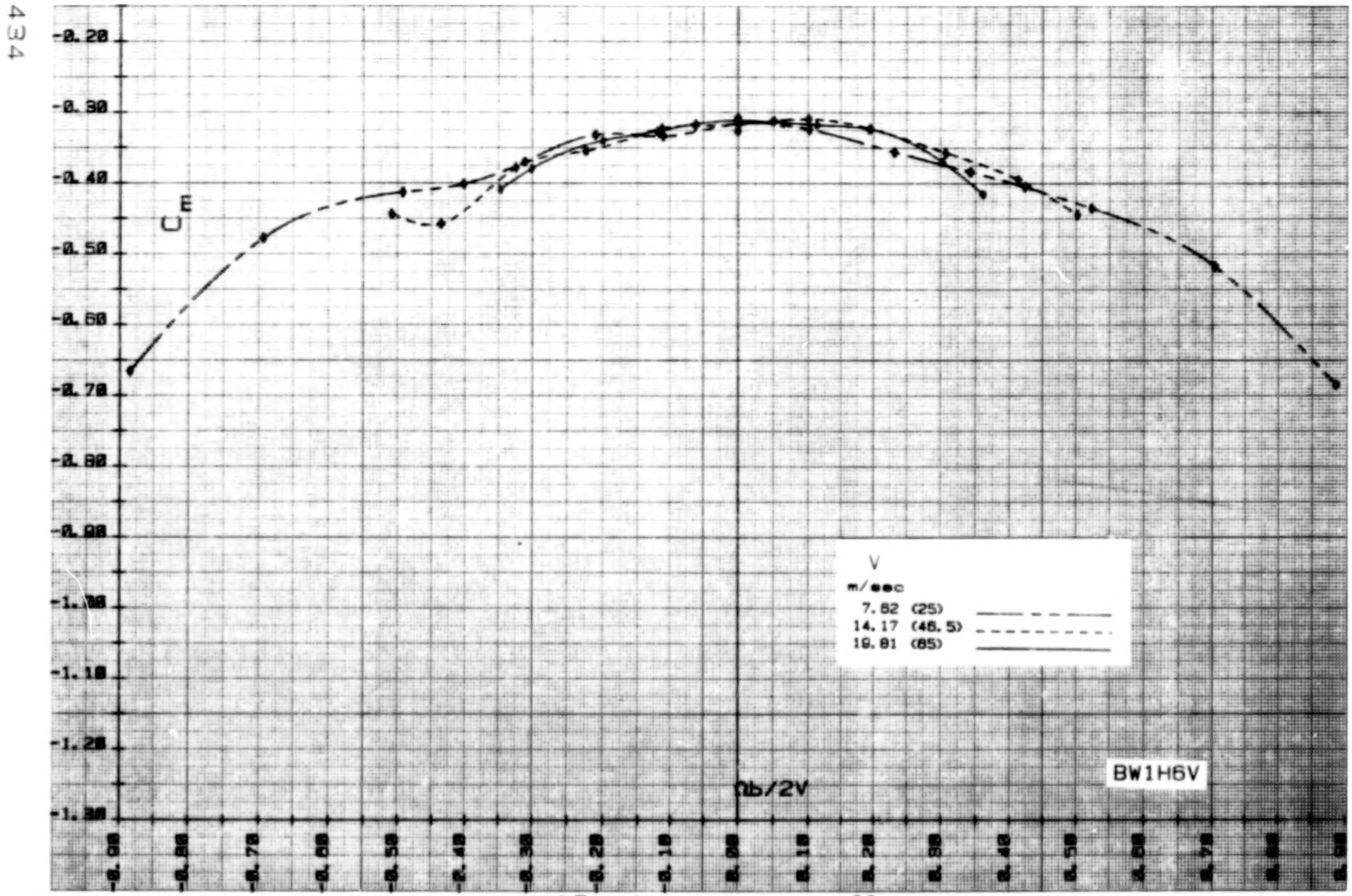
Figure 53.-Aerodynamic forces and moments vs Ωb/2V for different combinations of Ω and V. Theta=30 degrees.



b.) Rolling-moment coefficient.

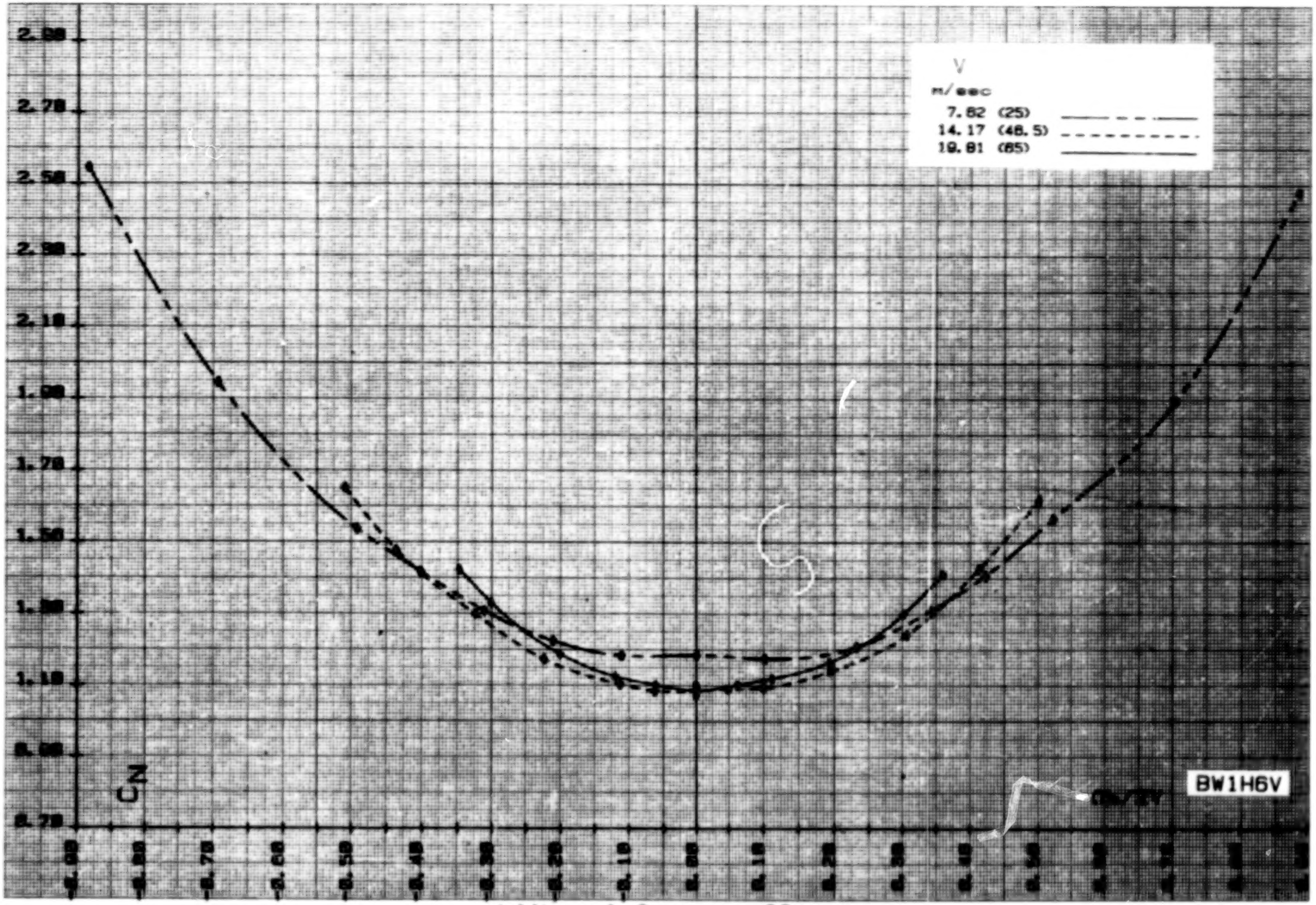
Figure 53.-Aerodynamic forces and moments vs Ωb/2V for different combinations of Ω and V. Theta=30 degrees.

433



c.) Pitching-moment coefficient.

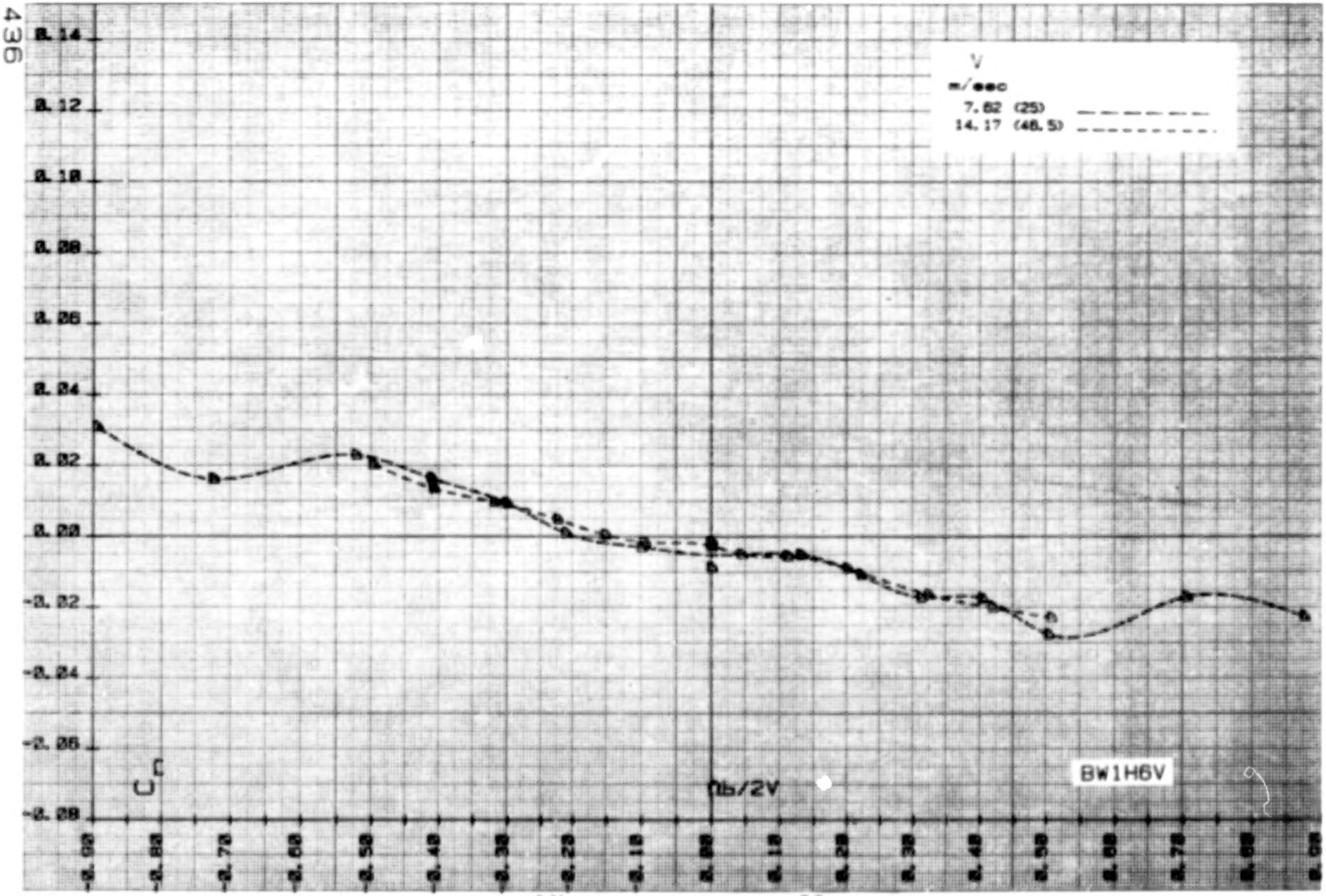
Figure 53. -Aerodynamic forces and moments vs Ωb/2V for different combinations of Ω and V. Theta=30 degrees.



d.) Normal-force coefficient.

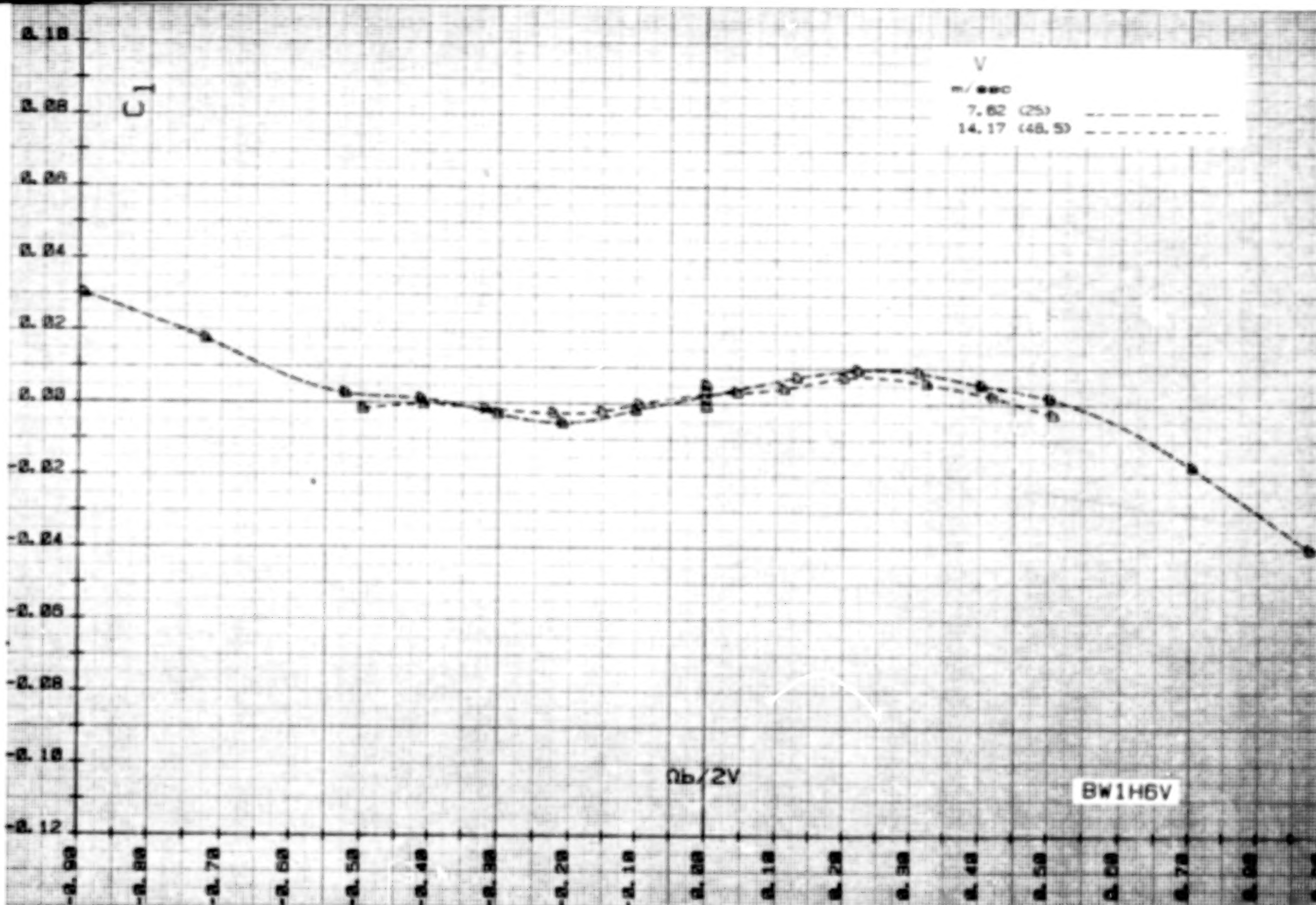
Figure 53.-Aerodynamic forces and moments vs Ωb/2V for different combinations of Ω and V. Theta=30 degrees.

435



a.) Yawing-moment coefficient.

Figure 54. - Aerodynamic forces and moments vs Ωb/2V for different combinations of Ω and V. Theta=60 degrees.



b.) Rolling-moment coefficient.

Figure 54.-Aerodynamic forces and moments vs Ωb/2V for different combinations of Ω and V. Theta=80 degrees.

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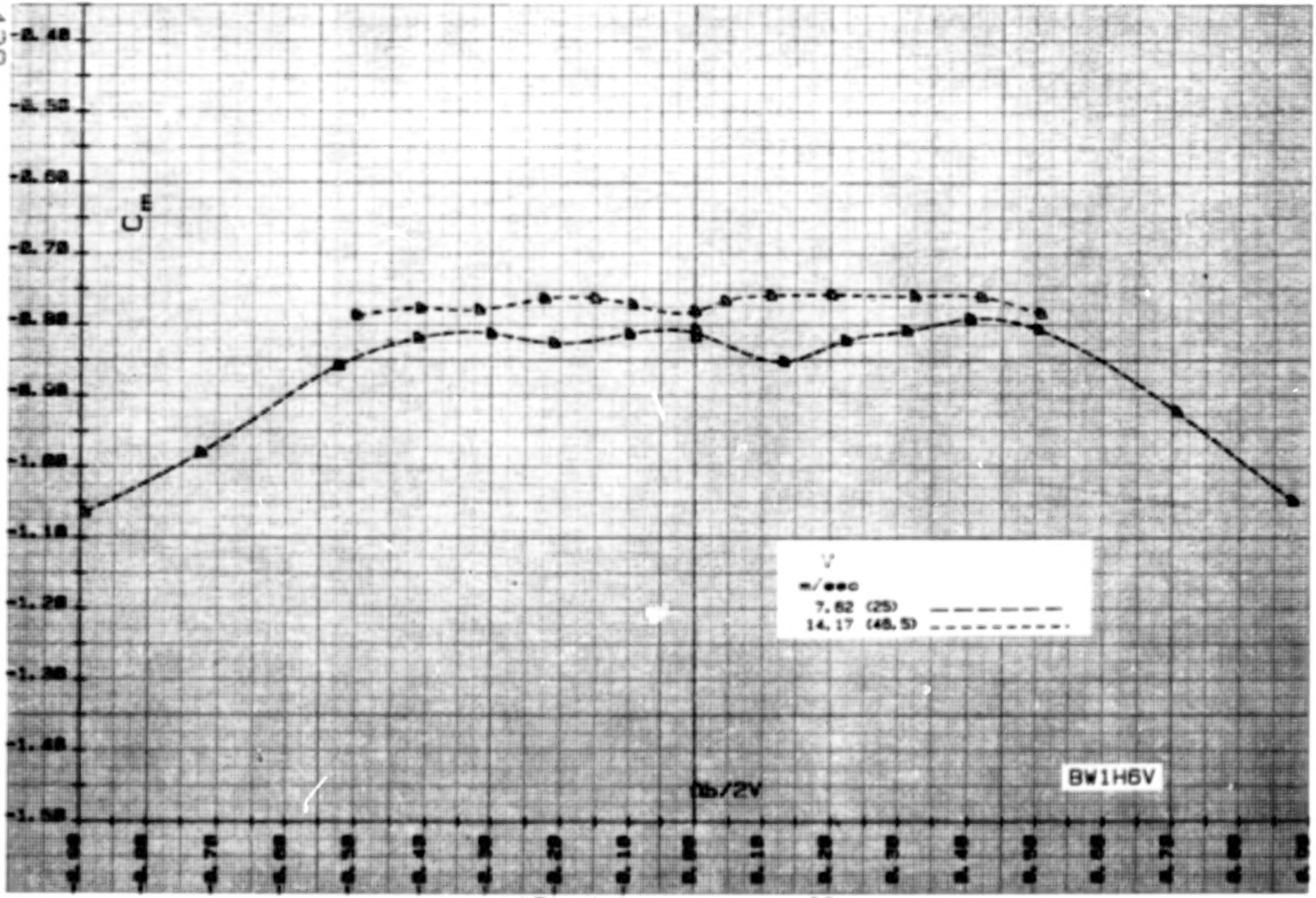
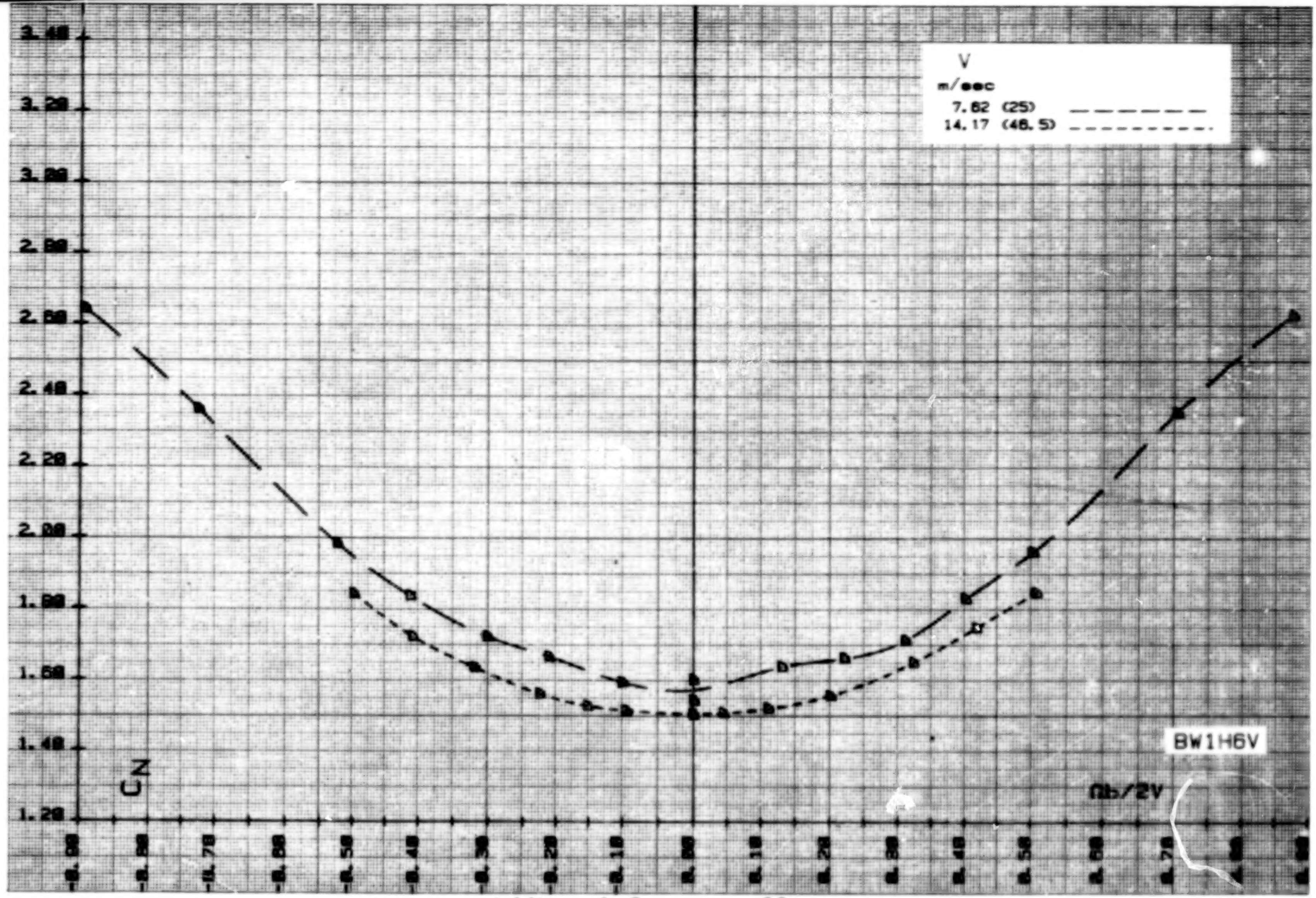


c.) Pitching-moment coefficient.

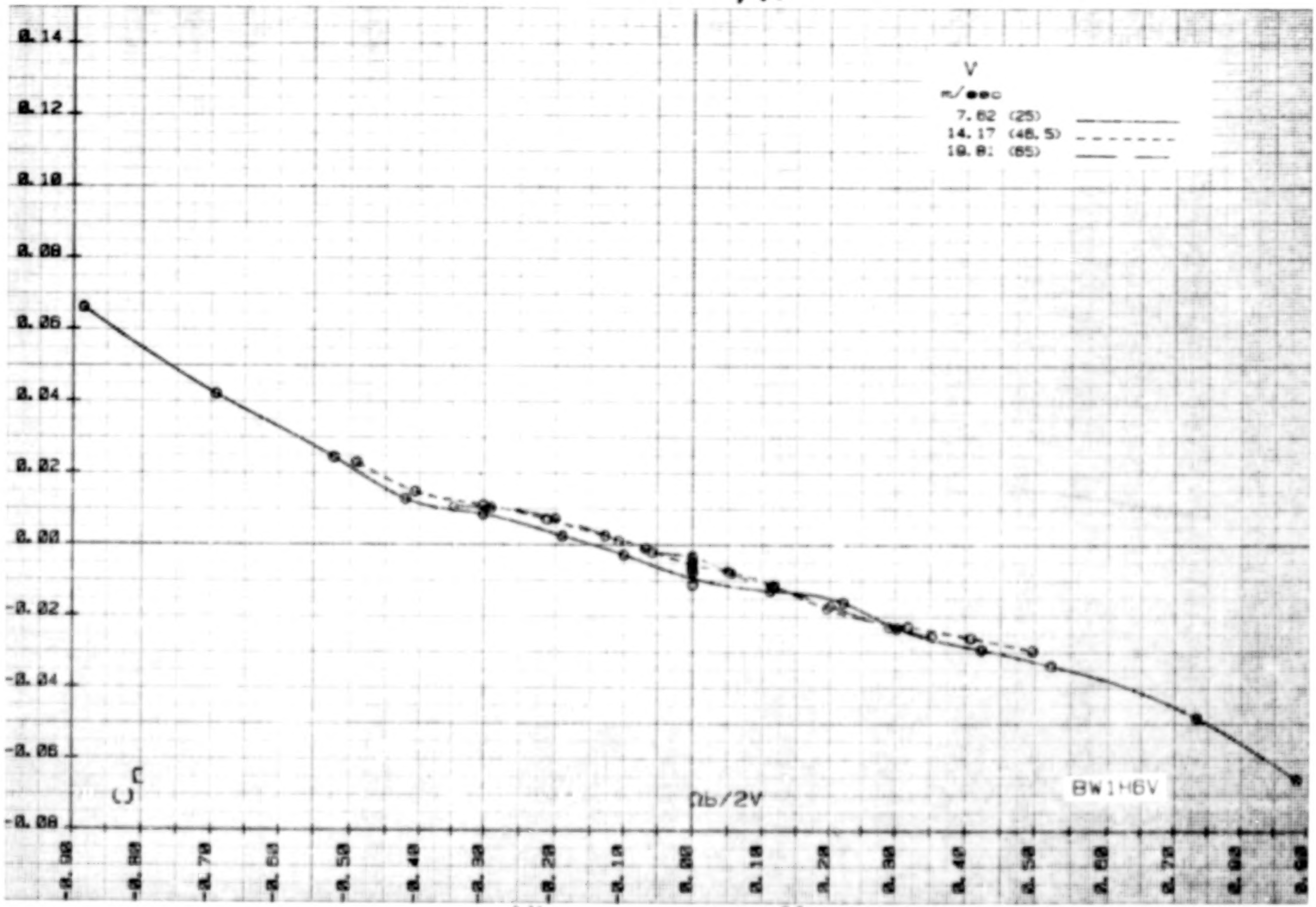
Figure 54.-Aerodynamic forces and moments vs Ωb/2V for different combinations of Ω and V. Theta=60 degrees.



d.) Normal-force coefficient.

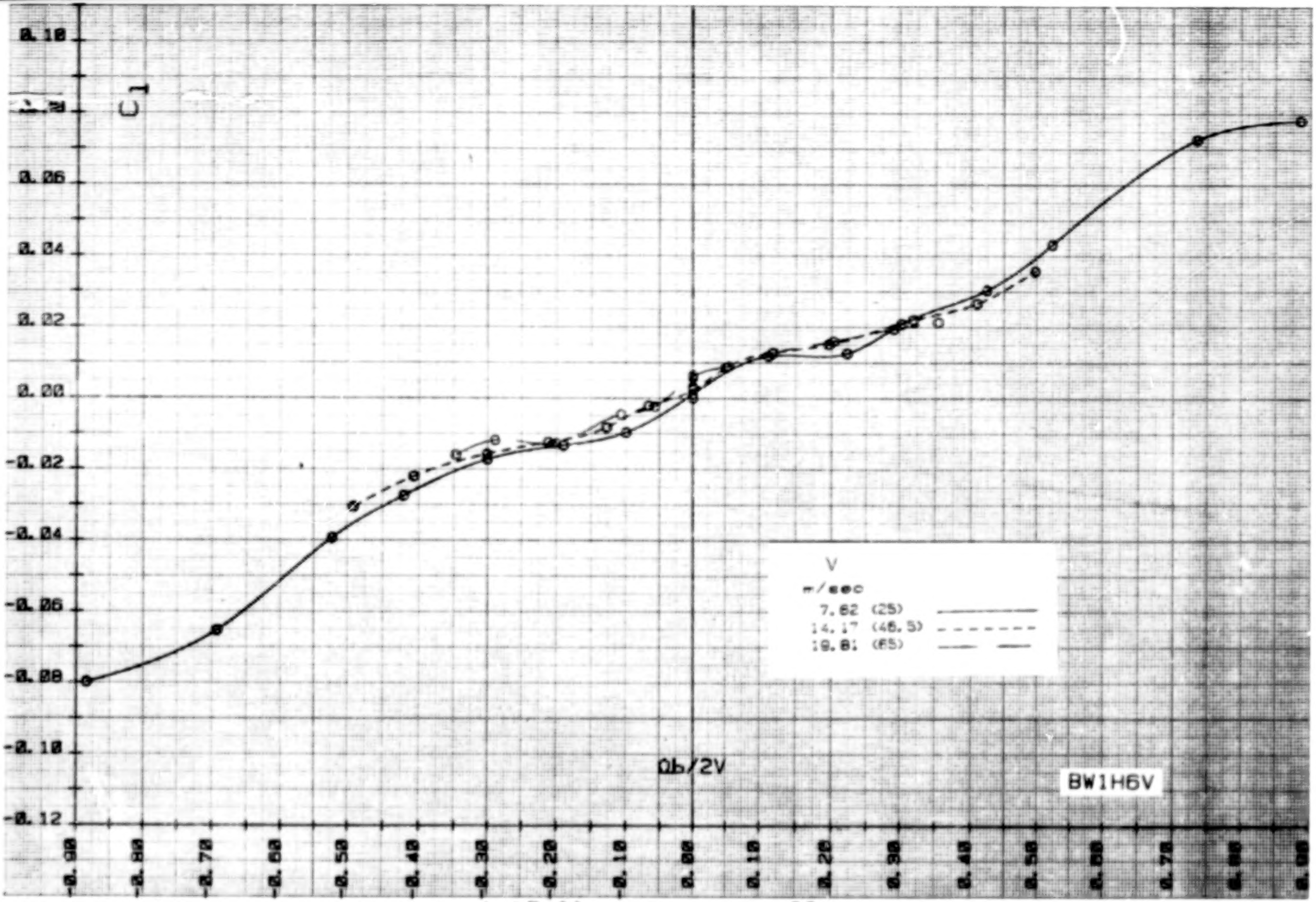
Figure 54.-Aerodynamic forces and moments vs Ωb/2V for different combinations of Ω and V. Theta=60 degrees.

439



a.) Yawing-moment coefficient.

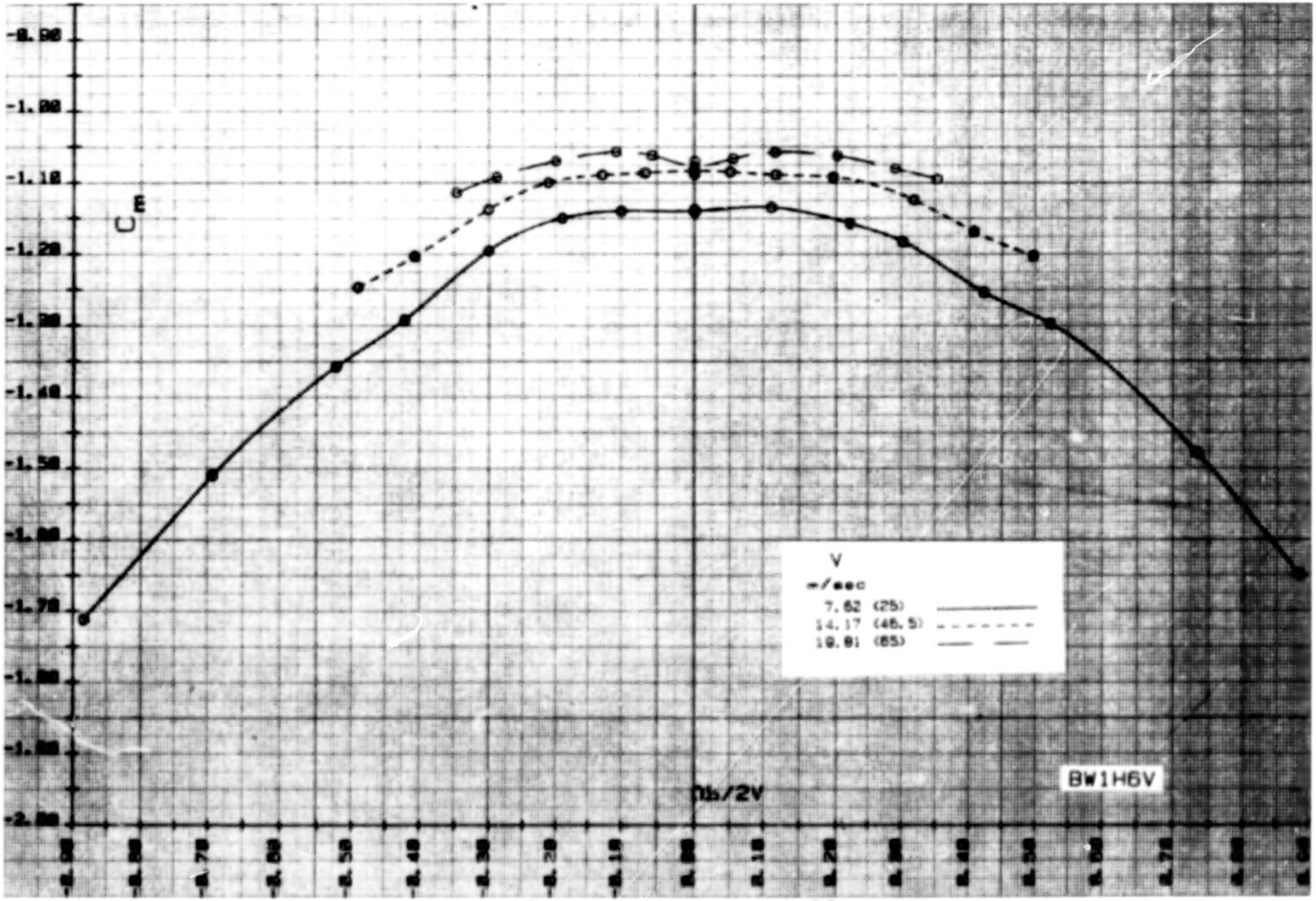
Figure 55.-Aerodynamic forces and moments vs Ωb/2V for different combinations of Ω and V. Theta=90 degrees.



b.) Rolling-moment coefficient.

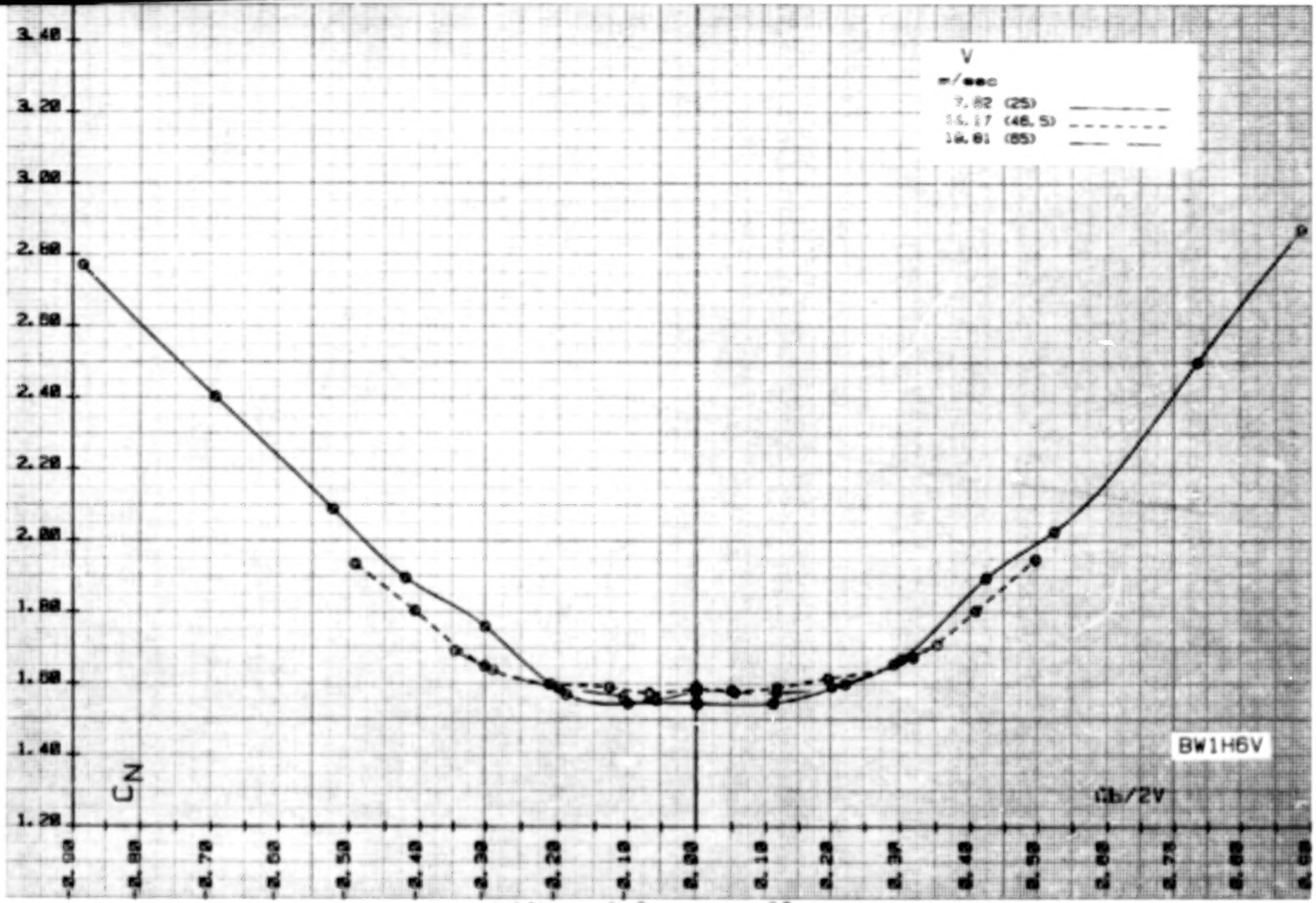
Figure 55.-Aerodynamic forces and moments vs Ωb/2V for different combinations of Ω and V. Theta=90 degrees.

441



c.) Pitching-moment coefficient.

Figure 55.-Aerodynamic forces and moments vs Ωb/2V for different combinations of Ω and V. Theta=90 degrees.



d.) Normal-force coefficient.

Figure 55.-Aerodynamic forces and moments vs Ωb/2V for different combinations of Ω and V. Theta=90 degrees.

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16. Abstract

Aerodynamic characteristics obtained in a spinning flow environment utilizing a rotary balance located in the Langley spin tunnel are presented in plotted form for a 1/5-scale single-engine low-wing general aviation airplane model. The configurations tested include the basic airplane, various airfoil shapes, tail designs, fuselage strakes and modifications as well as airplane components. Data are presented for pitch and roll angle ranges of 30 to 90° and 10 to -10°, respectively, and clockwise and counter-clockwise rotations covering an $\frac{\Omega b}{2V}$ range from 0 to .9. The data are presented without analysis.

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